

THE  
EDINBURGH SCHOOL  
OF  
MEDICINE:

CONTAINING THE  
PRELIMINARY OR FUNDAMENTAL BRANCHES  
OF  
*PROFESSIONAL EDUCATION,*  
VIZ.  
ANATOMY, MEDICAL CHEMISTRY, AND  
BOTANY.

Intended as an  
INTRODUCTION TO THE CLINICAL GUIDE,  
THE WHOLE FORMING A COMPLETE SYSTEM OF MEDICAL  
EDUCATION AND PRACTICE ACCORDING TO THE  
COURSE OF THE EDINBURGH SCHOOL.

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IN FOUR VOLUMES.

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## P R E F A C E.

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**I**N the volumes which have been published under the title of the **CLINICAL GUIDE**, the object of their Author has been to form, as it were, a set of School Books for the Student of Medicine, which may prove of the same utility in the study of this science, as such elementary pieces are in the earlier part of life to the acquisition of the languages, and the other parts of primary knowledge. By this means, the student is at once initiated into a general acquaintance with the subjects he is afterwards to pursue in detail; and again, when fully acquainted with them in detail, he can recur to the same elementary pieces in order to recall to his mind the extent of the subjects which have occupied his attention, and which, in the hurried routine of practice, he

is apt in many leading particulars to forget. This intention of the Author has been so far executed in the volumes that have already appeared, and the Public has sanctioned the design by their favorable reception; but, to complete the plan, and render the work a full system of Medical Education, the preliminary branches which form the foundation of the profession become a necessary and indispensable introduction. These branches comprehend the principles of Anatomy, of Chemistry, and of Botany, considered strictly in a medical view. The execution of this last part is now brought forward. In performing it, the great object the Author has had in view, has been to follow the arrangement of that celebrated School, which has so much benefited the Profession; and by the labours of whose teachers Medicine is no longer to be considered in the light of a conjectural art. The History of the Edinburgh School may be considered as the History of Medicine in modern times; and, from the era of Boerhaave to the present day, it has regulated in a great measure the views of Medical practice. The first, to whom this University was indebted for its Medical reputation, was the

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late Dr. Monro, who was not only the founder of the Anatomical department, so ably extended and improved by his successor, but was the original promoter of the Clinical Lectures, a mode of conveying practical science superior to every other, and since followed in every Medical seminary. But, though Monro was seconded by some men of abilities, they were too much attached to the Boerhaavian tenets, to take those new views of their particular departments which were reserved for their successors. Rutherford, cautious and slow, pursued the beaten track of regular, and at that time, approved practice. Plummer filled the Chemical Chair as an able commentator on the lessons of his master, and invented that combination of antimony and mercury which still retains his name. It was the introduction of Cullen into this University that changed the face of Medical Science. While the Lectures of the Dutch *Æsculapius* had given to Medicine a scientific, but often a fanciful form, it was reserved for the Edinburgh School, through him, to introduce into it inductive reasoning, to build on the foundation of Newton and Locke, and to substi-

tute facts for speculative opinion. In doing this, Cullen was ably seconded by his colleague, the late Dr. Gregory; who, with the acquisition of professional science, was zealous also to blend the duties of professional character. The joint labours of these colleagues being successively devoted to teaching the Theory and Practice in rotation, afforded to the student different views of the same subject, and allowed him to appreciate the relative merit of each. The same variety was likewise afforded him in conducting the Clinical Lectures, and the opinions of the different teachers were thus subjected to the test of practice, and their comparative merit as Clinical Physicians brought forward. Nor, while the Theory and Practice were thus ably supported, were the other branches of Medical Science left behind, the Chemical Chair was resigned by Cullen to the illustrious Black, and the Anatomical Theatre received an increase of fame from the descendant of Monro. Botany was taught on an extended scale by the patient assiduity of Hope, and a garden raised under his inspection, equal, if not superior to any in Europe. To the abilities of these men alone, does the

School of Edinburgh owe its reputation. While Cullen gave a new form to reasoning in Medicine, Black gave science to Chemistry. Monro detected many of the minute parts of the animal structure which had not hitherto been completely ascertained, and Hope extorted the applause of discovery in Botany from the indefatigable genius of Linnæus.

In the following work we have endeavoured to reap every advantage from the Lessons of this School, and to pursue the arrangement which has been generally adopted in it. Not that we have neglected to take the benefit of the discoveries of others elsewhere, or that we have exclusively own a blind veneration for the doctrines of that seminary; but it will readily be allowed by every competent judge, that no where is Medicine taught so ~~ably~~ as a science as in that University, and no where are its departments so well adjusted as to embrace the full extent of its different objects.





THE  
ANATOMICAL GUIDE;  
OR,  
A VIEW  
OF THE  
*ANATOMY AND PHYSIOLOGY*  
OF THE  
HUMAN BODY,  
IN THE  
SOUND AND MORBID STATE;  
WITH THE  
APPLICATION OF CHEMISTRY,  
AND THE CHIEF MODES OF ANATOMICAL PREPARATION  
WHICH HAVE BEEN EMPLOYED IN ORDER TO  
FACILITATE THE EXPLANATIONS OF  
ITS STRUCTURE.



## P R E F A C E.

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**T**HE Study of Anatomy, as the foundation of Medicine, is a truth so well established, and so universally acknowledged, as to leave no room for observation. The progress it has made of late years is the best proof of its acknowledged importance; and the numerous works which have been published, shew the curiosity of its votaries unsated in their desire of improvement. The object of the present publication has already been explained, as forming an introductory part to another work; and it is only necessary here to explain the plan that has been adopted in prosecuting the principles of Anatomy.

To combine a knowledge of the human structure, both in a sound and morbid state, is what the application of the subject demands. We shall

of this kind have been generally confined to the former, and the Anatomy of disease has been therefore lame and imperfect. To include both these objects in the same treatises, has not been attempted in such a manner as to give clear ideas of the latter, and except from the very masterly work of Dr. Baillie on the Morbid State, where the appearances of disease are clearly and methodically arranged, little advantage is gained by a student in consulting the larger works.

In the following pages, after a short History of the Science, we have introduced the subject by a General View of the Human Structure, so as to give a full idea of its several parts and their connections; we have then arranged it into its several divisions, beginning, as is common, with the basis of the body, or the Osteology, from thence proceeding to the softer parts, and last of all to the Anatomy of Disease. In finishing each part, we have examined the principles of its composition so far as Chemistry has been able to detect them; and, after this examination, we have considered the method of preparing it for a more full inspection, or for the purposes of the Anatomist.

The size of this work does not admit much elucidation of the subject by plates. A few, however, are given, which it is hoped will be found correct, and the work may be read along with the best plates of different authors on particular parts of the subject.





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GENERAL HISTORY  
OF  
ANATOMY.

---

I.

THE Science of Anatomy, like most others of importance to society, claims a remote antiquity. The common accidents of life, the business of war, and the slaughtering of different animals as food, would naturally afford opportunities of observation on their form and structure which would lay some foundation for this branch of study.—But such casual observation cannot be considered as any regular commencement of the science. This can be dated properly no higher than the age of Hippocrates, who disjoining medicine and its auxiliary branches from philosophy, gives us the knowledge of Anatomy as far as it had then gone.

In prosecuting the History of Anatomy, therefore, it is to be only traced as a science from this

## ii GENERAL HISTORY OF ANATOMY.

æra, and distinguishing its different periods by particular *discoveries* or improvements, they may be arranged into ten divisions.

### II.

The *first* division, or æra, extends from the time of Hippocrates to that of Aristotle. The knowledge of Anatomy at the first part of this period, seems to have been chiefly drawn from the dissection of animals; neither does any distinction seem to have been made between the arteries and veins, and between the nerves and tendons. At its conclusion, however, the distinction between the first seems to have been known, an attention paid to the state of the pulse, and the knowledge of the subject even assisted by the use of delineations or *drawings*.

### III.

The *2d* æra reaches from the time of Aristotle to the discoveries of *Hierophilus* and *Erasistratus*. During this period considerable improvements appear to have been made in Anatomy in consequence of the study of it by the Alexandrine Academicians, and the encouragement of the Egyptian Princes, who were frequently present at their dissections. At the conclusion of this æra, some knowledge of the *Laticals* seems to have prevailed, and the proper name and office of the

## GENERAL HISTORY OF ANATOMY. iii

*Nerves* was assigned. Accurate descriptions also of the principal organs occur, and even of some of their minute parts.

### IV.

The 3d æra includes the state of Roman knowledge in Anatomy; but nothing here appears new, or aims at discovery, till the time of Galen. By this author the state of Anatomical Science was accurately detailed as far as it then went, and was wrought up into a system with much plausible physiological disquisition: a work which continued the Code of Medicine for no less than 12 succeeding centuries.

### V.

The 4th æra comprehends that long and dark period, from the overthrow of the Roman empire to the revival of learning in Europe. During this lengthened period, which reaches from the age of Galen to the rise of Vesalius, no improvement in Anatomy can be traced. The religion of the Arabians was a bar to dissection, and consequently to the progress of this science, while the Western nations were so much sunk in barbarism as to be incapable of prosecuting any particular study. At the conclusion, however, of this æra, some traces of the discovery of the *Lymphatics* appear, and the gravid uterus and ovum seem to have been rudely examined.

## VI.

The 5th æra commences with the labours of Vesalius, who, laying aside in a great measure the knowledge of former times, as delivered by Galen, trusted to his own dissections in his account of the human structure; and his account he also assists by *delineations* or *plates*, which for their beauty and accuracy are still admired. He is the first author that gives their proper names to the muscles. His improvements were followed by Fallopius and Eustachius, who gave likewise plates, and who at the same time made some lesser discoveries in the minute parts of the human structure.

## VII.

The 6th æra forms a period of less importance than the former, extending from the time of Vesalius to that of Dr. Harvey.—During this time the general description of the body was well understood. It was the physiology or knowledge of the economy that continued in a lame state. The attention, however, to the study of Anatomy was now general in Europe; and the termination of this period was distinguished by the important discovery of the circulation.

## VIII.

The 7th æra, beginning with the knowledge of the circulation of the blood, was also distinguished

## GENERAL HISTORY OF ANATOMY. v

by what may be termed the proper discovery of the *Lacteals*, formerly hinted at by *Hierophilus*—the first was the work of Dr. Harvey, whose reasoning and conclusions soon gained ground, and after some opposition in favour of the knowledge of the Antients, from whom he was considered by some to have wrested his discovery, his opinions gave a new turn to the practice of medicine. The second, or the discovery of the *Lacteals*, was reserved for Ascellius, who thus traced the progress of the nourishment into the system as Harvey had previously done it in its perfect or elaborated state by the circulation.

### IX.

The 8th æra is distinguished by various improvements in the arts of preparing the body for examination, and by different accurate descriptions of the human structure, corresponding with Dr. Harvey's ideas. Discoveries were also made during this time of several minute parts belonging to particular organs; and the conclusion of this æra was marked by another important discovery, that of the Valvular Lymphatics by Bartholine and Rudbec.

### X.

The 9th æra is remarkable for the labours of Malpyghi and Ruysch, to illustrate the discoveries of preceding authors, and to detect the structure

## vi GENERAL HISTORY OF ANATOMY.

of the minute parts of the body by injection, and by other modes of preparation, and also by a comparison of the human structure with that of animals, or what is termed *Comparative Anatomy*. This æra terminates also with the attempt of Lower, founded on the discovery of the circulation to cure diseases by the art of *transfusion*.

### XI.

The 10th æra commences with the institution of the different learned societies throughout Europe, when a spirit of experiment and investigation shewed itself every where alive. But in anatomy less now remained to be done. The leading principles of this science were sufficiently known, and it remained for the moderns chiefly to improve by accuracy and fullness of description, by elegance of delineation, and neatness of preparation, the subjects already treated and brought forward.—In Morbid Anatomy, or the illustration of disease, they have indeed been more conspicuous than in any other part. The structure of the gravid uterus has also received much new light from the investigation and plates of Dr. Hunter, and the Valvular Lymphatic system has been detailed with precision, and its proper offices ascertained and established by the labours of Hunter, Monro, and others.

## XII.

In rating the merit of different countries in the relative progress made by them in this science, the Dutch and Italians certainly deserve the preference in respect to their investigation of the structure of Man; while the British and French, particularly the former, have studied more the explanation of its œconomy; by ingenious experiments, have endeavoured to throw light upon it, and to apply what is known to the success of practice.





## INTRODUCTION.



## I.

**AS** the office of a physician consists in removing disease, a previous knowledge of the structure of the parts in which it is seated, becomes indispensibly requisite.

## II.

This knowledge is attained by Anatomy, or the art of opening the body, so as to discover the situation, form, connexion, and properties of its several organs; and from a change in these, more or less apparent, constituting disease, a division of Anatomy comes to be formed into two parts, that of the *Sound* and that of the *Morbid* state; the latter being properly illustrated by a comparison with the former.

## III.

The body, whatever the particular state or condition it displays, we find always a composition of

matter variously arranged, and assuming either a solid or fluid appearance. A general view, therefore, of this arrangement, forming a system or whole, on the proper connexion of which both its existence and œconomy depend; is a necessary introduction previous to unfolding its division into parts, or noting the different appearances and composition of the latter.

## IV.

*General View of the Animal Structure.*

Every animal, besides those signs of existence displayed by the vegetable kingdom, is distinguished more or less by a *certain unseen and voluntary impulse* or inclination arising from its sensibility; which, though unconnected with the matter of which it is formed, constitutes the principle of its *action*.

## V.

Action in the animal is requisite for the possession of life, and it may be properly said to consist in *motion*. By this action, the parts subjected to its influence, are experiencing a constant change in the particles of their composition; and by this change they are exposed to unavoidable decay.—To prevent such decay taking place, or supply that unavoidable waste, the consequence of action, *certain powers* are assigned to particular organs of the body, named those of *sense*, by which a

judgment is formed of such substances as possess a capability of being assimilated or converted into animal matter.

## VI.

As all substances do not possess this capability, a selection of them becomes essential; and in order to make this selection, a change of situation is required.—Hence the animal must possess the faculty of transporting its body from one direction to another. To do this, some basis is necessary, or part stronger than the rest, to form a support to the latter. This part is distinguished in the body by the appellation of *bone*, the composition of which, to avoid unnecessary weight, and at the same time to preserve an equal breadth of surface for the connexion of the softer parts, is internally of a concave structure.

## VII.

That motion may be permitted by means of this basis or support which the system receives from bone, certain divisions in the latter become necessary, and these divisions are differently made, according to the extent of motion that is required. Thus,

1<sup>st</sup>. When a bone is divided into two, and the extremities of it are intended for motion, that this motion may be permitted at the place of their junction, a softer substance is interposed under

the name of cartilage, to prevent an excess of friction, and increase their agility.

2d. But where this motion is demanded in a less degree, or might even prove fatal by affecting the situation of some principal organ; instead of this substance being merely interposed, the bones as in those of the breast and back, are firmly joined by a greater quantity of it.

3d. Where this motion is required to a much greater extent than the simple addition of cartilage permits, which is a firm substance without any cavity; the bones become also surrounded by a strong kind of membrane which contains within it a liquor for lubricating the cavity or joint it forms, named ligament.

### VIII.

By this variety of structure, are the bones or basis of the body fitted for motion; but in order to its taking place, they must be connected with certain substances of a less solid nature, which possess the power of contraction.

These substances are termed *muscles*. They are composed of fibres of a soft succulent texture, exceedingly numerous to afford them sufficient strength.

### IX.

By the contraction of the muscles, one bone more moveable, becomes drawn towards another.

less so; and in order to effect it, the extremity of the muscle falls to be inserted near the joint of the former bone, where the motion of it is most freely permitted. But from the quantity of fibres of which a muscle is composed, the breadth of surface at this part would be deficient for their insertion: hence their number is concentrated into a more solid substance, named *tendon*. In certain parts also, even the substance of the muscle, though concentrated into tendon, would not admit a sufficient contraction for the degree of motion required; as in the fingers and toes, where a number of joints intervene. Besides, therefore, the muscle being converted into tendon, it becomes necessary, in order to increase its effect, to tie it down at different places by a sort of ligature or sheath, directed across it.

## X.

Thus by the connexion of the muscles to the bones is motion permitted; and it is made by securing one part of the body, in order to give freedom of action to another. The consequence of motion is the procuring of aliment, which is first divided by the hands, then applied in sufficient portions to the mouth, where, from the exertion of the jaws it is separated more minutely into pieces by the teeth, and when sufficiently comminuted, it is pushed down by the muscular power of the tongue and throat into its proper receptacle of the stomach.

## XI.

The *stomach* is seated in the belly, and is a chief mark of distinction between the animal and vegetable structure. It consists of a muscular part, with certain coats for containing the aliment. From its termination is continued a long gut named the *intestinal canal*. Into it the food descending, is by its muscular exertions pushed downwards till, reaching its extremity, the feculent portion comes to be discharged.

## XII.

Hence, of those substances introduced by the stomach as convertible into animal matter, part only is received into the constitution; and, previous to this taking place, it undergoes in its descent into the stomach, and also in this organ, a certain change, by mixing with a variety of liquors, the general property of which, is, to approximate it nearer and nearer to the animal composition. On its passing from the stomach into the intestinal canal, it becomes there absorbed by a number of vessels pervading its surface, and extending to the mesentery. Their size increases as they proceed, and they join at last into one duct which rises along the spine, named the *thoracic duct*; and it terminates at the subclavian and jugular veins. At this termination, the liquor named *chyle*, or what is separated from the food by means of the

intestinal vessels or lacteals, is received into the mass of blood. By the mass of blood it is distributed through the body, and thus nourishment is distributed to every part. For this purpose the blood possesses a constant state of motion, or has passages by which it is conveyed to the different parts of the system.

## XIII.

On examining the nature of the blood, it consists of four distinct parts :

1<sup>st</sup>. A quantity of air easily detached on exposure, which exhales in the form of a thin vapour.

2<sup>d</sup>. A red part named the globules, which affords colour to the whole, and is composed of a number of round particles, compared in their form to a shilling or a thin cheese, being the heaviest part of the mass.

3<sup>d</sup>. An aqueous liquor, with a proportion of salt of a particular kind, differing both from the vegetable and fossil alkali, and this part is termed properly the serosity.

4<sup>th</sup>. A tough part or gluten named also the coagulable lymph, appearing most abundant in inflammatory diseases.

These parts on venesection are discovered in the following order :

1<sup>st</sup>. The internal air contained in the blood flies off.



2d. By the admission of the external atmosphere, the gluten or lymph is coagulated.

3d. The red globules by their weight fall to the bottom, or come to be intangled by the gluten.

4th. The serosity is seen to separate.

#### XIV.

In respect to the uses of these parts, the serosity preserves the fluidity of the whole mass; and likewise the figure of the red globules. By the gluten it acquires a body, and any exudation of the former into the different cavities, is prevented from taking place. To the red part is owing the momentum of the blood, and its difficulty of passing to the extreme vessels.

#### XV.

This fluid as essential to the support of the body, is abundantly distributed through its several organs. It begins from the *heart*, a large muscular organ situated in the superior part of the body, of a conical figure. To its superior part on one side is attached a large vessel, named the *vena cava superior*, to distinguish it from that named the inferior, by which the blood is returned from the inferior parts. Where these again meet, a large sac is placed, or part projecting, like the external ear of an animal, named the *auricle*. Below this, another cavity of a similar nature is discovered, termed the *ventricle*; and, as the veins are furnished with

## INTRODUCTION.

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valves, by which the blood when advanced is prevented from returning, once received into the *auricle*, it is there compressed by the action of its muscular fibres; and, an opening taking place between the auricle and ventricle, it is by this compression next determined into the ventricle. This opening being covered with a valve, named the *tricuspis*, like the veins, it yields only in one direction; hence, when the same action in the ventricle is exerted from the incapacity of the blood returning to its former situation, it is next inclined to a large vessel termed artery, which divides into two branches. These branches advance into the lungs, are there separated into minute portions, and after circulating the blood through these organs, they return it again by corresponding veins which unite into one trunk, that terminates on the other side of the heart, in a sac or auricle similar to the former. In like manner, below this sac, there is a ventricle from which the blood is pushed into a passage that forms the beginning of a considerable vessel, named the *aorta*. As the aorta makes an arch at its origin, from this place of it branches are derived to the head and arms, while its chief trunk goes downwards, and by separating into a number of small vessels, which at last anastomose and become too minute for observation, it communicates the circulation to the inferior parts. The extremities of those vessels again being fur-

nished with corresponding veins, the fluids they transmit are returned through these veins, by their junction in the *cava* to the heart.

## XVI.

From this view the heart possesses two sides, a right and left, both similar in their appearance. Through it the blood circulates twice, for it is returned to it before undergoing the general circulation, after being either in some manner rectified, or receiving an additional quality, as chemistry has attempted to shew, by its distribution in the lungs.

## XVII.

To perform the circulation, then four parts are required:

1<sup>st</sup>. A vein by which the contents of the thoracic duct with the reflux blood, is conveyed to the heart.

2<sup>d</sup>. An auricle in the latter to which the vein is united, which becoming distended by its fluid, is made to contract, or is forced into action.

3<sup>d</sup>. A ventricle, which in consequence of this action of the auricle receives its contents, and from them receives, when accumulated, a similar impulse. And,

4<sup>th</sup>. An artery by which this accumulation of the ventricle is discharged, and transmitted to the different parts of the body.

## XVIII.

In this transmission, the mode and time in which these parts severally act, merits consideration.—

For the auricle and ventricle alternate with each other, and the artery again agrees in the time of its action with the auricle; while the distribution of the fluid through it, is effected by the impulse of the ventricle driving into its trunk a greater quantity of blood than it is capable of containing. This occasions its swelling out at that part to which the blood is first directed, and from the resistance of its coats to this extension their contraction is excited, which forces an alteration in its contents, and hence it communicates a stroke to the finger when applied. The same also takes place in succession through its whole extent; yet at its extremity this contraction becomes rather weaker, by reason of its distance from the heart, whose power is here insufficient for its excitement. When the blood therefore comes at last to the vein, it moves in a more insensible and uniform manner, without any alternate stop, as occurs in the artery.

## XIX.

The use of this general circulation of the blood, besides conveying nourishment to the several parts of the system, and preventing the coagulation of the mass of fluids; tends also to unload it of those parts, which in consequence of putrefaction or

some other morbid change, are rendered unfit for being longer detained in the body: for thus, by its constant motion, they are exposed to the different outlets, and perhaps too some farther alteration in the chyle, besides being merely converted into blood takes place.

## XX:

Thus the circulating mass we have found composed of different parts; and as the arteries and veins divide into minute branches, it is natural to suppose some of them become so exceedingly minute as to admit only certain parts of it. Of these vessels named *lymphatics*, there are several kinds.

1st. Those which, though still connected with the general circulation, admit only the serum or its serosity.

2d. Those which, unconnected with the general circulation, secrete from it certain parts for the nourishment of particular organs as the joints, the eye, the bowels, &c. named *secerning*.

3d. Those which take up from the cavities to which they are conveyed, the fluids secreted by the *secerning* vessels, named therefore *absorbents*, and terminating in the colourless veins.

## XXI.

But besides these vessels which circulate only the blood, or particular parts of it, we find this fluid in

certain situations of the body entirely altered in its nature by other vessels of a more complex texture, connected together in a convoluted manner, under the appellation of *Glands*. The manner in which these act to affect this change, is unknown; and from each a passage leads for the discharge of their secretion, termed the *Excretory Duct*. Their use, however, seems important to the system. By secretion, the several motions of the joints is allowed. In the same manner the hurtful or useless parts of our mass of fluids is expelled; and, by an arterious separation, nutrition itself is performed, and the species of animals preserved.

## XXII.

To a similar operation, the action of the mind, perhaps, or the power of thought, may be ascribed. It depends on the *brain*, which is evidently a glandular substance, in which the principle of impression resides, and by which it is communicated. The *brain* is of a white colour, divided by anatomists into two portions; the upper named the *cerebrum*. the under the *cerebellum*; and from these certain cords of the same appearance are produced. The principal of these cords descends, covered by the back-bone, named the *spinal marrow*; others pass from the bones of the head, and each separating into different

portions, the latter are distributed over the several parts of the system, by which sense and motion are allowed. Where they take their origin, they are covered by certain membranes, to which the names of *Dura* and *Piamater* are applied; and as they are of a soft pulpy texture, these membranes serve to defend them from being injured by the compression of the other parts.

## XXIII.

In this manner is the animal structure completed; and over the different parts of it described the skin is thrown, being connected to the muscles by means of an intervening substance, named *cellular*. By the sensibility of the skin, danger comes to be avoided; and from its porous nature, what is hurtful to the body is allowed to be discharged.

## XXIV.

Thus, from the view of its constituent principles, the body seems naturally divided into two parts, a solid and fluid, the latter depending for its action on the former, and both requiring to be jointly considered. This is commonly done under two general heads, distinguished by the names of Osteology and Splanchnology. Laying aside this common arrangement, we shall prosecute the subject more properly under three divisions:  
of

1. *Simple Demonstration*, consisting in the examination of the bones or hard parts, which is commonly preferred in their dried state.
2. *Dissection and Demonstration*, where the softer parts are first unfolded by the knife before they become the subjects of investigation. And,
3. *Morbid Anatomy*, or a view of the changes produced by disease, where, in addition to the former means, the farther arts of injection and preparation are required.

Part I. *Demonstration of the Hard Parts, or  
Osteology.*

XXV.

Osteology, or the history of the bones, is that division which considers those parts of the structure that serve for the support, defence, and attachment of the rest, constituting, as formerly observed, its basis. From the other parts they differ, by possessing in their composition a greater quantity of earthy matter, which proportionally increases their stability; hence, when burned for a considerable time, they lose but a third part of their weight, consisting of that portion of oleaginous matter intended for lubricating their texture, and increasing its nourishment. Thus they are the most permanent and indestructible parts of the animal



structure, and they continue the memorial of it when all the other parts are annihilated.

## XXVI.

Every animal solid consists of a fibrous structure; and though in the bones this is more compacted than in the soft parts, yet by means of heat and other methods of maceration, variously employed, they can be made to separate into different layers or laminæ when this fibrous texture is apparent. These laminæ, however, and their arrangement, is most visible in the extremities of some bones, where also the cavernous structure is most conspicuous, intended for the reception of a certain quantity of marrow, which by entering into the composition of bones, and bestowing on them a degree of pliancy, add to their power of resisting any force directed against them. Hence, in old people, where it is defective, their rigidity renders them more liable to fracture, or this accident takes place from slighter causes than in young subjects.

## XXVII.

The marrow is contained in a membrane proper to itself. This is called the *internal periosteum*, for the external surface of all bones is covered in like manner by a membrane named the *external periosteum*. This membrane is connected to them by a number of threads, many of which are blood-vessels entering into the bones, and by that means

carrying on their circulation. Perhaps at first they were all so, though gradually as solidity advances, they lose their primary use. This membrane of the bone is loosely connected to the neighbouring parts by a substance resembling cotton, termed the cellular membrane; only the fibres of it are compacted into layers, and when drawn out, this membrane by its elasticity, is brought back to its proper place. It passes also from one articulation to another, over the intervening substance.

## XXVIII.

*Formation of Bone.*

The formation of bone has much divided the opinions of Anatomists, and the peculiarity of its structure to external appearance has made them lose sight of that reasoning, which is applied to the growth of other parts.

The 1<sup>st</sup> opinion referred this process to a *coagulable exudation* proceeding from the bone, and hardening by exsiccation into the same substance, after passing through the several degrees of consistency, from a fluid to a solid state. This opinion was afterwards modified by one author, who considered the exudation as *pure blood*, which on being effused, acquired all the after changes necessary to give it the proper color and hardness of bone.

## XXIX.

The 2d opinion, and a more plausible one was that which attributed the formation of bone to a secretion from its external membrane or the periosteum, founded on the supposed analogy between the bark and wood of a tree; and this opinion was attempted to be supported by a variety of experiments from the thickening and inflammation of this part in cases of fracture, and from the adhesion it always acquires to the bone at the seat of the injury.

## XXX.

The 3d opinion considered its growth as depending on the action of the internal vessels of the bone itself, and this opinion was supported by the first appearances of the bone, which so soon as consistent, displays a vascular structure, and that before any connection is formed with the periosteum.

## XXXI.

But, regarding all these opinions as proceeding from imperfect observation, the formation and growth of bone is to be viewed as a process that requires the concurring action of every part. That its deposition is in a particular manner assigned to the arteries, and that this deposition is made under various circumstances, according to the particular form or construction of the part.

Wherever, therefore, bone is to be formed, an increased arterial circulation appears, and this circulation appears always first in the centre of the jelly, cartilage, or exudation, where the bone is to be formed. In the same manner as the ossification advances, the arterial deposition withdraws; and, the red color which is first conspicuous, diminishes, from the centre towards the extremity of the part.

## XXXII.

Thus, in tracing the history of ossification, the first mark that appears is an artery running in the centre of the bed where the bone is to be formed, which is succeeded by others that form as it were a plexus of vessels from which a point of ossification begins and gradually extends, varying its color from the different shades, till it acquire the whiteness, consistence, and qualities of bone. Ossification, therefore, is a process in itself no way dependant on any intermediate texture for promoting or accelerating its growth, and totally unconnected with cartilage any farther than as it forms occasionally a bed for its deposition, which is equally formed by membrane or parts of a softer texture.

## XXXIII.

From this view, the color of a bone in a certain degree determines the progress of its ossification. An incipient redness shews the commencement of

the process, and this becomes gradually obscured. In long bones, the ossification proceeds in a number of circles or central points, and as these circles ossify, the redness removes from the centre or middle towards the extremities. Thus the arteries or vessels are lost gradually in their own deposition or secretion.

## XXXIV.

Hence, vascular action is the cause of every change in the animal structure, and the foundation of this change is communicated by the blood, which even acquires its elaborated or perfect state by the same means. To animalize whatever it receives, is the peculiar property of the system, and in doing it to appropriate this matter to the particular purposes required, the body is also furnished with different and varied powers of secretion. The secretion of earthy or bony matter in the foetal state hardly takes place. Cartilage here forms a temporary supply for bone, and this cartilage is afterwards gradually removed as the bony secretion is introduced in its place. Even in this introduction, the original form or structure of the part is preserved and extended by the very same powers which supply the secretion. The same means also which thus form and mature the bone, preserve it also in health. A constant deposition and a constant removal of its parts takes place in

a degree suited to what is necessary to continue its structure and consistence for performing the various offices of life.

## XXXV.

But bone is exposed to injury as well as the softer parts. Under this injury it is liable to take on various degrees of morbid action, and its secretion comes either to be impeded, or the absorption of its earth too much accelerated. Hence various degrees of brittleness and softness occur. Its proportion of earth forms the peculiar characteristic of bone, and the connecting medium of this earth, depends on a quantity of mucus. For the proper deposition of this earth, a sufficient action of the vessels is required; hence an interruption by motion of the part prevents a firm callus in cases of fracture from being formed, and a renewed excited stimulus, and even a division of the part is necessary before a complete firm growth can afterwards take place. Thus the action of the absorbents and of the depositing arteries bear a mutual proportion to the irritation applied.

## XXXVI.

The period of renovation and change in cases of bone, forms a curious subject of investigation. This has been particularly ascertained by the use of coloring substances, by which, in the space of 24 hours, the bones can all be tinged, and this

color can be removed or supplied at all times with almost equal rapidity. From this fact, a proof is formed that the vessels of the bones are equally active as those of the soft parts. Nay, cases occur, where, by the strong or too active exertion of their absorbents, the bones are partially removed, and even the whole of the bony system has been reduced to an almost gelatinous state.

Nor are the bones less endued with sensibility than the other parts. This is particularly shewn by the presence of inflammation, when pain far exceeding that of the soft parts, is produced in them.

### XXXVII.

From these facts, the vitality and organic nature of bone is sufficiently clear. It varies in the rapidity of its growth at different periods of life, and it is also interrupted by occasional circumstances of disease. Thus health and vigor forward its operations, and debility and disease arrest its progress. In general, it is completed about the 20th year; and though thus, on the whole apparently slow, yet certain parts are quicker than others, according to the necessity nature seems to require for the completion of their growth.

### XXXVIII.

The facility of ossification may be considered as depending on three circumstances:

1. The softness of the bed or nucleus, in which the bone is formed.
2. The size of the vessels that deposite the bony secretion; and
3. The number of points in which ossification commences.

## XXXIX.

*Division of Bones.*

After these few remarks on the formation of bone, it is proper to consider next its division. — This has been made by Anatomists into three different classes :

1. The 1<sup>st</sup> class includes those bones of a broad flat appearance.
2. The 2<sup>d</sup> class comprehends those which are long and round; and
3. The 3<sup>d</sup> takes in those irregular ones not reducible to the former two classes.

## XL.

*Connection of Bones.*

From the variety of structure in the bones, since they all require to be connected in order to answer their several uses, different methods of effecting this become necessary, regulated by the degree of motion they are destined to execute : for,

1. Where no motion is intended, the indentation of the ragged edges of two separate pieces, forms



a connection termed a future. This chiefly prevails in the bones of the head.

2. Where motion but only limited is designed, which the former indentation would prevent, a substance of a less solid nature, possessing a degree of elasticity is made to intervene and to form a junction under the name of cartilage. This connection chiefly appears in the different parts of the chest or thorax.

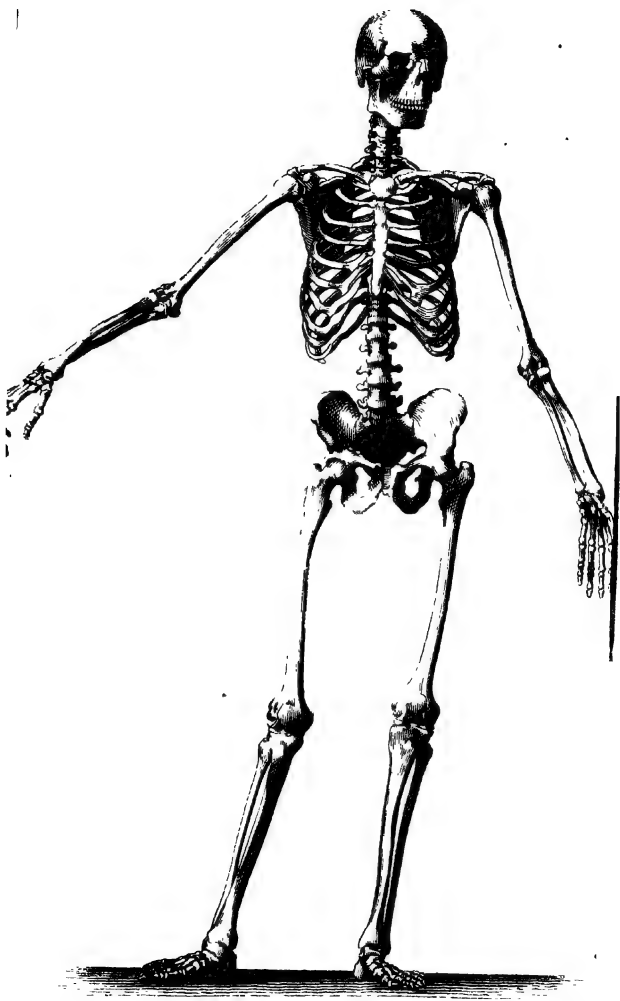
3. Where, on the contrary, no restriction to motion is intended, the extremities of the bones, instead of the former junction, are inclosed in a still softer substance, named ligament. They are also tipped with cartilage to increase the facility of their play, and within this ligament certain bodies are situated which excrete a liquor to preserve these parts constantly in a moistened state.

## XLI.

### *Dried Bones, or the Skeleton.*

From these modes of connection, especially from the first, the skeleton possesses a more numerous division of the parts of its structure than could be supposed from appearance. Their number is also increased according to the age of the subject, for ossification being in general slow, it begins in the same bone as formerly observed in several points; which, before uniting in the adult into one compact piece, renders every bone divisible into certain portions, and these portions are known by the





general name of Epiphysis, when situated at the extremity of the bone; though, after puberty, when from the increase of ossification their fibres unite so as to prevent any suspicion of their former separation, they are termed apophyses or processes.

## XLII.

In taking a general view of the skeleton, one is struck with the particular direction and situation of its several parts with regard to each other. Instead of its general pillar being placed perpendicular, it makes a number of turns, and resembles in its shape an Italic S. Hence, though in every situation the whole weight may be thrown on the common basis, or fall between the feet, yet a number of muscles are necessary to give support, and any one position soon tires, while to counterbalance this apparent inconvenience, by this structure a greater variety of motion is permitted.

## XLIII.

In describing the structure of the body, Anatomists have commonly divided it into three parts, the *head*, *trunk*, and *extremities*. This division we shall adopt as best calculated for a clear and regular elucidation of the whole.

## XLIV.

*Bony Part of the Head, or Skull.*

The most important part of Osteology is the skull, being that part which serves for the de-

fence of the brain, and which, of course, contains the organs of sense, and those powers which influence the rest of the system. The demonstration of it therefore requires to be accurate and minute, which is treated under two divisions, the Cranium, or Brain Case, and the Face.

## XLV.

*Brain Case, or Cranium.*

*Appearance.*—The Cranium very much resembles an egg with the small end turned forwards. This shape it seems evidently to take from that of the internal organ it covers, as being the mould on which its ossification is extended. Such a shape is certainly the best adapted to this part. It is capacious, resists accidents, and is convenient on various occasions, by offering a less surface of resistance from the flatness of its sides. Thus the ear is less exposed by it to injury, and the circle of vision is also considerably increased. In the various nations of Europe, however, the head appears to assume some slight variety of form; but this is more the effect of artificial compression than the moulding of nature.—Disease also has at times the same influence, but not in a great degree.

## XLVI.\*

*Structure.*—In dividing the Cranium by a horizontal section, the structure of its bones becomes

conspicuous, which consists of two tables and an intermediate diploe, similar to the cancelli of other bones. Of these tables or plates, the external is considered as thicker and more spongy than the internal. Consequently it is liable to injury, while the internal plate being more subjected to pressure, is denser and thinner, and has received the appellation of the *Tabula Vitrea*, or *Glassy table*. These tables are only parted by an inconspicuous space, which is filled up with the diploe: the diploe is a sort of membranous texture, covered with vessels whose office is to supply marrow and to nourish the bone, and which communicates with both the internal and external membrane of the skull.

## XLVII.

This texture of the Cranium is in general very regular, and therefore there is by no means the danger commonly imagined of committing mistakes in the progress of operations here. In the use of the trepan, the appearance of blood always marks the cutting of the diploe, and the future steps of perforation require the most guarded caution. In children the skull consists properly of one table; in youth, though completely formed, the thickness of its tables is less certain; and in old age it declines towards the state of childhood, or acquires a gradual thinness.—Pits and hollows.

from the impression of vessels, form also as life advances in different parts of the skull, which alter its thickness; and which being uncertain in their situation, require an operator to proceed with a guarded hand.

## XLVIII.

*General Division of the Skull.*

This general structure of the Cranium, when minutely examined, is composed of eight distinct parts:

1. The upper and fore part of the head is formed by the frontal bone, which extends a little to the temples, and gives the upper part to the socket of the eye.

2. The sides and upper parts of the head are composed of the parietal bones, which, by their name, are considered as the walls or sides of the skull.

3. The back part of the head and top of the neck is formed by the occipital bone.

4. The lower parts of the sides of the skull are inclosed by the temporal bones, which, from the change of their hair with age, gives their name as marking the progress of time.

5. The fore part of the basis of the skull is formed by the æthmoid bone, which, situated over the nose, is principally connected with the organ of smell.

6. The back part of the base of the skull is made up by the sphenoid bone, which lies over the throat, forming the back of the nostrils and roof of the mouth.

## XLIX.

### *Sutures.*

These several parts described are joined together by certain seams or indentations, named Sutures.

1. The first of these is the coronal suture, by which the frontal and parietal bones are joined. The extent of this suture is across the head from ear to ear, in one direction; and descending behind the eye, it enters the deep part of the temple, and changing its appearance, it becomes squamous instead of serrated. Its name is derived from the crown of flowers, or garlands, anciently worn on this part.

2. The second joining, or suture, is what has been termed the *Lambdoidal*. Its situation is behind the one ear; it then ascends and passes over the occiput like an arch, and it terminates by descending behind the other ear. From its form it resembles the Greek letter ( $\Lambda$ ), from which it derives its name.

3. The top of the head is intersected by the third suture, named the Sagittal, which extends between the two former sutures; and from this situation, as it resembles an arrow between the



string and the bow, it has been distinguished by this title.—A continuation of this future takes place, at times, to the very nose.

4. The temporal future, which connect these bones with the parietal, occipital, and frontal, forms the next joining to be noticed. This future makes an arch nearly equal with that of the external ear, it then connects itself with the coronal and lambdoidal futures, and it has been distinguished by the name of the Squamous or Scaly Suture.

5. The sphenoid and æthmoid bones, at their articulations, possess futures which are irregular, and correspond to the singularity of their shape.

6. Another joining to be noticed, is the *Transverse Suture*. It runs across the face, and joins the latter to the bones of the skull, by sinking down into the orbits. It is a future equally irregular as the former.

7. The last joining is that which connects part of the temporal bone to the cheek, and which, from forming an arch or yoke, has been termed the Zygomatic Suture. It is of small extent, and has the serrated edge only on one point.

#### L.

These several futures have been commonly divided, by Anatomists, into two kinds, the *true* and *false* futures; the former are distinguished by

their ferrated appearance on the outside of the skull, which appearance they lose within. These ~~futures~~ are three in number, viz. the Coronal, the Lambdoidal, and Sagittal. The latter, or false futures, are the temporal and transverse futures, which have more of the squamous than ferrated appearance at the edge. To these futures may added two additional ones, which are at times conspicuous; the one termed *ossa triquetra*, placed between the occipital and temporal bones, forming an addition to the lambdoidal future; the other, placed between the parietal and temporal bones, forming an addition to the squamous future.

### LI.

A knowledge of these different divisions of the skull is of the first importance to a Surgeon in forming a judgment where injuries of the head occur. Real futures are not always to be distinguished by their ferrated edge; neither does a fracture of the skull always run in a direct line, so as to distinguish it from a future. The most experienced will often be deceived in these cases, which points out at least the necessity for studying this part of Anatomy with much attention. It is also the more necessary, as the appearance of the futures described is not always regular, and a considerable variety prevails in different individuals.

LII.

To understand the subject properly, it is useful to trace here the manner and progress of ossification. The skull is originally in a soft and gristly state, consisting of an infinite number of pieces connected with the circumstances of its growth. The bones ossify from their centre to their circumference, by which they are more concentrated, or closer at their middle, and are more scattered and diverge at their extremities. As the opposite extremities of the bones meet, their scattered fibres grow into the interstices of each other, and thus in time, as ossification becomes bounded, the suture with its serrated edge comes to be produced.—In childhood the bones of the head are all connected by membranous expansions; the sutures are hardly yet beginning to close.—The substance of the bone is not divisible into its proper plates, and every part wears the appearance of imperfection, compared with the adult.

LIII.

In every stage of life, certain of the sutures are always conspicuous, however the rest may occasionally vary. These are, the sagittal suture in the middle of the parietal bones, the coronal over the forehead, the lambdoidal behind, and the squamous formed of the lower edges of the same bones. In the situation of these, therefore, no error can at any time take place.

## LIV.

The particular construction of the skull, and the manner of its growth, has been considered as attended with fundry advantages.

1. As accelerating the growth by the more numerous points of its ossification.

2. As causing its spherical figure to be more exactly formed.

3. As occasioning a more equal thickness of its parts.

4. As yielding by its divisions to the growth of the brain.

5. As accommodating itself to pressure in delivery.

6. As limiting the extent of fractures where injuries occur.

7. As admitting a dilatation when acted upon internally by disease.

8. As allowing a drain to take place more readily from the internal parts by the futures.

## LV.

But many of these advantages have been over-rated, and though they may take place to a certain degree, yet physicians have frequently built too much on this slight foundation, in pursuing certain modes of practice with respect to the formation of issues or drains, and also in forming an opinion with respect to the extent of fracture.

## LVI.

Having examined the general divisions of the skull, and its several connecting points or features, we now proceed with the particular detail of its separate pieces.

*Frontal Bone (Os Frontis).*

*General Description.*—The first of these is the frontal bone, compared in its shape to a clam-shell, from its internal hollowness and equal thickness. This hollow of the bone internally is divided equally into two by means of a spine or prominent line, the origin of the membranous partition dividing and supporting the hemispheres of the brain. Externally the ridges the seat of the eye-brows are its most conspicuous part, and also the two prominences, below which are situated the sinuses of this bone. Its chief irregularity lies in the orbital plates, or that part of it which forms a socket for the eye and a support to the lower part of the brain, and into the open space of which is inserted a principal share of the æthmoid bone.

*Particular Detail.*—In delineating its parts, the first to be noticed is the *Superciliary Ridges*, on which are placed the eye-brows, being an arched line corresponding in length to them, through which the different arteries pass to the bone, producing a strong adhesion of the teguments at this part. Here also, the frontal muscles arise, and among other holes for

the transmissiōn of vessels, one, in particular, passing obliquely through, termed the Superciliary Hole, deserves to be remarked. Through this hole proceeds a small artery from the orbit, which mounts over the forehead. As it passes the ridge, it is termed the Superciliary Artery, and when higher up, the Frontal Artery. By it a communication is established between the internal circulation of the eye and the external vessels of the forehead and temples. It is also joined by and carries along with it a small nerve, termed the Superciliary nerve. The termination of this Superciliary ridge is in the two processes which, from forming the angles of the eye, have received the title of *Angular*. And these processes are divided into the internal and external angles of the eye. Betwixt the internal angular process, is situated a sharp projecting point, exactly in the middle of the bone, named the *nasal point*. This point is rough and irregular, at its root so as to give a firm seat to the nasal bones. At the end of the superciliary ridge stands a rising or *bump*, the seat of the *frontal sinuses*, though it is sometimes wanting. The *frontal sinuses* are two in number, situated above the root of the nose, one at each side, and the two tables of the skull recede at this part to form them. Their hollow is of various depth, according to the age and other circumstances in the constitution of the individual,

for in the child they are entirely wanting. Each sinus is separated by a partition, though still there is a communication by a small hole; at times, however, both the partition and hole have been found wanting; but the communication with the nose always prevails, and it is by means of this communication, that the organ of sound is rendered more sonorous. The cavity of these parts is lined by a thin and sensible membrane, the same that is continued over the nose and throat. It possesses a secretion from its surface, which preserves it in a moistened state, and which, by the antients, was considered as drawing something noxious from the head.

## LVII.

The situation of the sinuses should be particularly attended to and declined in the application of the trepan, unless it is impossible to raise a fracture in an easier way. The sinuses are also the seat of a particular accident, viz. the generation of insects, but this we shall have occasion to treat under the head of Morbid Anatomy.

## LVIII.

On the internal surface of the frontal bone, the most conspicuous part is the *spine* or *ridge* to which the falx is connected, or that dividing membrane, which runs through the middle of the head and supports the brain. The prominence of this part

varies in different individuals, and also, according to age. It is greatest at its root, and lessens in its progress up the forehead, ending at times in a groove. In this groove is lodged the great longitudinal sinus, which observes the course of the falx attached to the spine. At the root of the spine is a small blind hole, at which the insertion of the falx commences.

The next part of the bone internally, that claims attention, is the *orbital process*. This process covers the eye on each side, departing from the general direction of the bone, and standing inwards. By the constant action of the eye, and the pressure of the brain, its plate is rendered thin and transparent. The former smooths its surface below, and the latter impresses it with frequent convolutions above.—Hence, from the thinness of this part, accidents here are frequently fatal, and easily penetrate the brain. Upon this orbital plate two depressions fall to be noticed in the socket of each eye; the one is small and deeper at the inner corner, being the seat of a small cartilaginous pulley for the tendon of one of the muscles of the eye; the other a pretty large diffused hollow for receiving the lacrymal gland, or that gland which secretes the tears and gives moisture to the eye.



## LIX.

At first the frontal bone is composed of ~~two~~ pieces, which division often remains in the adult, particularly in females; and by this division the sagittal suture comes to be continued to the nose. When the two pieces unite together, their edges are turned inwards as meeting with least resistance.

## LX.

*Parietal Bones (Ossa Parietalia).*

The parietal bones compose a very large part of the skull, and are therefore most subject from their situation to injury, which is here much easier removed in cases of fracture by the trepan. This bone also is pretty uniform in its thickness, though marked internally with a number of depressions from the sinus, and the circulation of the membranes of the brain.

*Particular Detail.*—In their figure the parietal bones are square, they are united together by deep serrated edges, and in the same manner to the occipital and frontal bones. The corners of both bones are obtuse. One of these corners however runs out to a great length, and has been named the Spinous process of these bones. On their lower edge they are concave, and of a semi-circular form where they join the temporal bones, the edge of which overlaps the edge of the parietal, and forms by its thin scale the squamous

future. A little above this future is a white semicircular line, which marks the origin of the temporal muscle. Where the two bones unite and form the sagittal future, a groove is conspicuous, equal in size to the finger, and fitted to contain the longitudinal sinus. Its size is most apparent on fitting the two bones to each other. The great artery of the dura mater traverses this bone at different parts, and in various directions, and is so buried in the lower corner of it, that the trepan could not applied without wounding it.

In the parietal bone there is but one hole through which a small vein and artery pass to the sinus and falk.

### LXI.

Two circumstances require to be noticed in the parietal bones. The first is their connexion with the frontal, which is somewhat curious, for the upper part of the os frontis is supported on their arch; but as, at the sides, the parietal is more in danger of being compressed, the parietal now passes over the frontal; and at this part the frontal is remarkably strong, so that this part of the head has every advantage that can be given it for resisting pressure.

The second circumstance is the state of these bones at birth, at which period there is a want of bone where the two pieces of frontal bone in the

adult join with the parietal ones, and the ossification here extends in a very gradual manner, for children are generally two years of age before the ossification is completed. On laying the hand on this part, also a considerable motion is felt from the pulsation of the vessels, which has occasioned it to be named the Fons Pulsatilis, or Bregma.

## LXII.

*Occipital Bone (or Occipitis).*

The occipital bone is the thickest of the cranial bones, but varies considerably in its degree of thickness in different parts. Into it are inserted the chief muscles of the head and neck, it gives support to the brain, it contains the cerebellum, and transmits from its opening its prolongation, or the spinal marrow.

*Particular Detail.*—By the impression of the muscles this bone is particularly marked on its external surface; and the first of these impressions running across, is termed the Transverse Spine; below which, another is also conspicuous, making it double. The interstice between these impressions makes a prominent ridge, which crossing the former ridges, is termed the crucial spine; and this part of their crossing being prominent, is named the Posterior Tuberosity.

Internally the bone displays a similar surface, making one transverse line of regular smooth

crucial ridges. To the great internal ridge is attached the transverse partition, which divides the brain from the cerebellum, and known by the name of the *tentorium cerebello super-extensum*. In the corner or angle where this membrane is fixed, lies the great sinus, which dividing here to right and left, is named the lateral sinuses; and in its continuation downwards to the neck, they form the *jugular veins*. Where the longitudinal sinus divides into the lateral, a triangular groove is formed, which follows the course of the ridges. The transverse ridge also is surrounded with four smooth hollows, the two uppermost of which contain the backmost lobes of the brain, and the two under ones contain the cerebellum, being thus intersected by the tentorium.

## LXIII.

The processes of the occipital bone are three in number. The first, lying in the very base of the skull, and joining the occipital to the sphenoidal bone, from its shape resembling a wedge, is named the cuneiform process.

The two others, which are buttons, standing off from the foramen magnum, flattened and of an oval form, termed condyles, prevent the head from turning or rolling, but allow its motion backwards and forwards.

## LXIV.

The holes of this bone are the last part to be noticed. The principal one is the foramen magnum, which transmits the continuation of the brain or spinal marrow. Its edges are smooth, thicker at the lip, and firm behind in order to give a firm attachment to the ligament of the spine. Through this hole passes also the vertebral vein, and by it are returned the vertebral arteries and the spinal accessory nerve.

The 2d hole, placed at the root of either condyle, is sometimes double, and transmits the great lingual nerve.

The 3d hole, exactly behind the condyle, is sometimes wanting. It gives passage to the cervical vein of the neck to enter the great lateral sinus; and when wanting, this vein passes by the occipital hole.

## LXV.

In the fœtus, the occipital bone is divided into four pieces, the first reaches from the middle of the lambdoidal suture to the foramen magnum; the 2d and 3d are placed at the sides of that foramen, and the 4th forms the cuneiform process. It has been also supposed that the sagittal suture is sometimes continued to the foramen magnum, as well as to the nose; but there is nothing in the formation of the bone to countenance it. In the

operation of the trepan it is laid down as a rule, that this bone ought to be avoided on account of the continuation of the longitudinal sinus, as also of the lateral ones: but cases may occur where the surgeon is to balance between the danger that attends the performing the operation, and the neglect of it, as where the bone is beat in upon the brain: but should the depression happen to be situated between the ridge which serves as the boundary between the smooth part of this bone and the lambdoidal suture, there is no danger; and if an extravasation happens, this is one of the best places for making an opening, the blood or matter falling by its weight upon the membranes that divide the brain and cerebellum. It is even possible to raise a piece of depressed bone lower than the lateral sinuses, within the ridge formed by the muscles. There is also a possibility that the skull may be fractured here without having received a blow: if a person fall with violence, especially an old person, the condyles may be pushed upwards, of which there are instances.

## LXVI.

*Temporal Bones (Ossa Temporum).*

The temporal bones are very irregular in their thickness, in their depressions, and in their different points. They originally consist of two pieces, distinguished by the names of the pars petrosa, and

*pars squamosa*. The former is hard and irregular, triangular in its shape, and juts inwards towards the base of the skull, and by containing the organ of hearing which renders it unequal, it is the medium or depository of all the nerves which are connected with the ear. The latter thin and scaly, rises over the lower part of the parietal bone, and is smoothed by the action of the temporal muscle. It is grooved also to form the squamous suture, and is exceedingly thin on its fringed edge.

A third portion of the temporal bone, thick, hard, and divided into cells, forms caverns for the reverberation of sound; and this part is termed its occipital angle. It is connected with the other bones by the *additamentum futuræ squamosæ*.

#### LXVII.

The first process of the temporal bone is the zygomatic, which, with a process of the cheek bone, marked by an intervening suture, forms the yoke or arch of the temple, under which the temporal muscle passes to the lower jaw. It is broad and flat at its origin, and gradually diminishes as it approaches the cheek bone. From the upper edge also of this arch is stretched to the parietal bone a firm tendinous covering over the temporal muscle; and from this place also several muscles arise which belong to the face, particularly the

masseter and zygomaticus, the one moving the jaw, the other drawing the angle of the mouth.

The 2d process is the Styloid, so named from its resemblance to the antient pen. It continues long even in the adult in a cartilaginous state, and it is only firmly ossified in age, when its length at times exceeds two inches. Its situation is behind the jaw, standing obliquely out from the head, and giving origin to a ligament which supports the os hyoides, and to several muscles which belong to the throat and jaws. These muscles are all named from this process, and from the part to which they belong; and from their situation their action is directed to pull upwards and backwards.

A small rising or ridge of the bone has received the name of the Vaginal process. It is however properly the root of the Styloid process, though it has been noticed as a separate one.

The 3d process of the temporal bone is the the Mastoid or Mammillary, projecting from under the ear; easily distinguished by the external feel, and resembling somewhat the point of the thumb. By this process, which is internally hollow, the tympanum or outer cavity of the ear is enlarged. Under its root is attached the dygastic muscle, and the point of this process gives origin to the mastoid muscle before, and behind



to several others that take all this general title along with their particular appellations.

The 4<sup>th</sup> process forms the outer margin of the hole of the ear, and is named the auditory process. It is a small arch of bone, rough and irregular in its edge. Upon it is extended the membrane, or what is termed the drum of the ear. Till adolescence, it is a distinct ring laid upon the rest of the bone; but after that period it is found firmly united to it. As well as the extension of the drum upon it, the cartilaginous tube of the ear is also affixed to it, for it extends from the root of the mammillary process to that of the zygomatic.

#### LXVIII.

The holes of the temporal bone are numerous and important, and they are either connected with the organ of hearing, or with the circulation to the brain.

1. Of the former, the 1<sup>st</sup> is the external opening of the ear or meatus auditorius externus, covered with its membrane, which communicates that motion from the air necessary to the action of the internal organs.

2. The internal opening of the ear, or meatus auditorius internus, is a large hole situated upon the back of the triangular pars petrosa. At first it is a smooth regular circle with a rounded lip, perforated internally with several small holes; by

means of which the auditory nerve, or rather the portio mollis of it, is distributed and expanded over all the cavities of the ear, so as to form the true organ of hearing.

3. A small pin-like hole appears on the fore-part of the petrous bone, which receives a small nerve of the 5th pair, that enters the ear, and joins the portio dura of the auditory nerve.

4. Before the mastoid and behind the styloid process, is the hole that gives passage to the portio dura to the cheek, and hence it is named stylo-mastoid hole.

5. The last and most important opening of this bone, is that for the eustachian tube, or the passage through the throat to the ear. (*Iter a palato ad aurem.*) The whole of this passage is irregular, broken, and ragged. The tube itself appended to it, is entirely cartilaginous. Its form is that of a trumpet, long and winding; wide at its entrance to the throat, and gradually contracting as it advances to the ear. It is the state of this tube that occasions an alteration of the voice and hearing under a cold; and it is also the impression on it which occasions a crackling sound on shutting the mouth and blowing the nose. This part gradually falls off with the soft parts, and is wanting in the skeleton.

Of the holes transmitting the circulation to the brain.

1. The 1<sup>st</sup> is that which, situated at the root of the styloid process, and near the point of the petrous bone, gives entrance to the carotid artery, the principal one of the head which passes through the bone in the form of an Italic S; and for which the opening is fitted by making instead of a hole, a short crooked smooth canal for this purpose. By this mode of entrance to the head, the impetuosity of the circulation is probably retarded, an opinion confirmed by analogy.

2. The 2<sup>d</sup> opening is for the transmission of the great lateral sinus to the neck, where it assumes the form of the internal jugular vein, and this opening which is large and lacerated, is composed equally by the temporal and occipital bones. Sometimes it is divided into two, one transmitting the vessel, the other the eight pair of nerves in their passage to the stomach.

3. In the occipital angle of the temporal bone, there is also a small hole for the passage of a vein into the great sinus, or an artery to the dura mater.

## IX.

In the foetus, besides the division of this bone formerly noticed, there is no appearance of mastoid or styloid process; and instead of a *meatus externus*, there is only a ring of bone, in which the *membrana tympani* is fixed.

It has been laid down as a rule, that the trepan should never be applied to the temporal bone, but this opinion seems improperly founded on the idea of the injury to the tendons which cover it producing fatal irritation. Fractures may occur here in several ways, the bone may be forced inwards, a fissure from the top of the head may extend downwards, where the cause is violent, from the parietal bone through the suture, or by force applied to the top of the head, the lower part of the parietal bone may stand outwards and break the scale of the temporal bone.

## LXX.

*Ethmoid Bone (Os Ethmoides).*

The ethmoid is a light spongy bone, convoluted so as to resemble a honey-comb, and perforated with an infinity of holes for receiving and distributing the organ of smell, which has caused it to be termed the cribriform or sieve-like bone. It is inclosed between the orbital processes of the frontal bone. One horizontal plate gives opening to the olfactory nerves, which are received upon it through a number of perforations, and other plates again receive in their course those nerves, and expand them so as to form the organ of smell. By the convolutions of these plates, the surface of this sense is extended, and the parts of the ethmoid bone performing it, are termed its spongy

bones. In the orbit of the eye there is one flat plate of this bone, which is smooth from the rolling motion of the eye, and is therefore named the os planum. Thus in its different parts the ethmoid bone supports the brain, comprises in part the socket of the eye, and forms entirely the organ of smell. But its principal division is its cribriform plate, to which the olfactory nerves adhere, and lying upon it, they shoot down their roots through its perforations as already noticed.

## LXXI.

The processes of this plate to be distinguished are :

1. The crista galli, a small perpendicular projection, so termed from its resemblance to a cock's comb. It divides the plate into two, by rising directly in its middle, and it gives attachment to the falx of the dura mater. On each side of it is placed an olfactory nerve, on the forepart of its root there is a notch ; which contributes in part to the formation of the blind hole (*foramen cecum*) of the parietal bone.

2. Opposite to the crista galli, stands out in the same perpendicular direction the nasal plate, or commencement of that partition which divides the two nostrils. It consists of a thin firm process of solid bone, inclining a little to one side : it is united with the vomer, and the latter again

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with the cartilage, on the fore or project. 121  
of the nose. the

3. From either side of the septum or partition, depends a spongy, or, as it is termed, turbinated bone, covered with a delicate membrane, on which the olfactory nerves are expanded on leaving the cribriform plate of the ethmoid bone, and by the convolutions of this bone, the powers of smell are extended. These convolutions take place in a much greater degree in other animals of acute smell, than in the human subject. With these convolutions, the spongy bones display also a number of cells, by which the effluvia drawn up, are detained longer in the organ.

4. On the inner side of either eye lies the orbital plate of the ethmoid bone, firm, smooth, and polished, and in shape a regular square, resembling when in its place a separate bone, and termed the os planum.

5. In the inner corner of the orbit, just over the nose, is placed another part of the ethmoid bone, termed from its thin scaly appearance and shape, the os unguis. In this part is situated the groove which holds the lacrymal sac, and conducts it into the nose. Its perforation therefore takes place in those cases where the passage has become obstructed.

6. Along with those parts, the cells of the ethmoid bone are not to be omitted. They are

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angly numerous in its spongy substance, bone<sup>s</sup> into rows, divided by partitions, and the os planum and the os spongiosum have each their separate cells. These cells are 12 in number, though they sometimes vary.

In the foetus the ethmoid bone is divided into two by a cartilaginous partition, which afterwards forms the nasal plate and the crista galli.

### LXXII.

#### *Sphenoid Bone (Os Sphenoides).*

The sphenoid is the most irregular shaped bone in the body, and has therefore been compared to a wedge, to the figure of a bat, &c. It lies in the very basis of the skull, and closes the cranium below, being connected to all the other bones of the cranium by its future. Through this bone is transmitted almost all the nerves of the brain, and its body therefore is trifling, compared with the importance it derives from its numerous openings.

### LXXIII.

1. The 1<sup>st</sup> of its processes are what are termed its temporal ones, or wings, from lying in the hollow of the temple, and by their junction with the frontal, parietal, and temporal bones, they have a share in forming the squamous future.

2. The 2<sup>d</sup> process of this bone is the orbitary, where its wing forms the outside of the orbit of

the eye. Its situation is exactly opposite to the os planum, with a regular smooth surface.

3. The 3<sup>d</sup> process is the spinous, and consists of a narrow point at the back part of the bone, which sinks under the petrous portion of the temporal bone. Through a small hole in it also, the great artery of the dura mater enters.

4. The 4<sup>th</sup> process is the styloid, projecting like a small peak within the condyle of the lower jaw from the basis of the skull, and giving rise to a muscle of the palate.

5. The next process is the pterygoid, which in the figure of the bone compared to a bat, represent its feet, and are, properly, four in number, two external, and two internal. Each of the former is thin, flat, broad, and hollow without, where the external pterygoid muscle has its origin. The latter is narrower and longer, has its end tipped with a small hook, and with its fellow forms the back part of the nose. Between the two processes, the eustachian tube comes down in a wide groove, and opens behind the internal process, or behind the nostril, and over the back of the palate. The hook of this process, or backmost point of the palate, is termed the hook of the palate, over which the circumflex muscle of the palate moves, turning with a small tendon round it. The great muscles of the lower jaw arise like-



wife from the pterygoid processes, and take their names from this origin.

6. The azygos, or single process of this bone, projects from under its middle and forepart. It stands over the centre of the nose, and gives a firm attachment to the vomer or bone of partition, which with the united azygous process of the ethmoid bone, forms the upper and back parts of the septum.

7. The clynoid, the next processes are four in number. They consist of four little knobs, so termed from their supposed resemblance to bed-posts. The two anterior ones terminate each in a sharp point projecting backwards. The two posterior ones, are situated transversely, someway behind the anterior processes, rising with a broad and flat process, which divides into two knobs, and inclining obliquely forwards towards the former processes.

The space inclosed by these four processes, is named the turkish saddle, or sella-turcica ephippium. It lodges the pituitary gland, whose use is unknown. On each side of this part also, the carotid arteries rise, and mark a groove in it by their circulation. The optic nerve also lies in a groove at the forepart, betwixt the two anterior processes. Some few alterations take place in these parts on some skulls, by a connection of the anterior and posterior clynoid processes in one.

This bone is also distinguished by possessing an irregular cellular texture in different parts. These cells no doubt perform the same office as the cells of the former or the ethmoid bone.

#### LXXIV.

The holes of the sphenoid bone are even more numerous than its processes.

1. The first are the optic holes, which are large, round, and transmit the optic nerve through a groove in each, and along with the nerve the ocular artery also passes in a twisting manner round the nerve.

2. The next hole is a wide slit, termed the foramen lacerum, under the anterior clinoid process. It extends outwards, sharp, and flat; it is wide near the sella turcica, and turns gradually narrow as it approaches the temple, where it ends in a slit. Through this part the third, fourth, and the first part of the fifth, and sixth pair of nerves, and the ocular vein pass. These nerves are all connected with the organ of sight, and are therefore appendages to the optic in their offices.

3. The 3<sup>d</sup> opening is the round hole, or foramen rotundum, named from its shape, and placed a little behind the foramen lacerum. Through it is transmitted the second part of the fifth pair of nerves, which goes to be distributed on the upper jaw.

4. The foramen ovale is an oval hole, farther back and more external than the former, or about  $\frac{1}{2}$  inch behind it. It gives passage to the third branch of the fifth pair of nerves, and also to the veins which accompany the principal artery of the dura mater.

5. The spinous hole, or foramen spinale, the next in order, and in the very point of the spinous process, is a small round opening immediately behind the former. Through it is transmitted a small artery, the principal one of the dura mater, and which makes an impression on the parietal bone.

6. The last opening is the pterygoid hole or foramen pterygoideum. This hole differs from the rest in not giving exit to a nerve or vessel, but in returning into the head a reflected branch of the second part of the fifth pair of nerves. This opening is situated under the root of the pterygoid process, is only to be seen in the separated bones, and besides its common name is termed also the Vidian hole.

7. Besides these openings enumerated, sometimes one or more small passages are discovered in or near the sella turcica, for the transmission of blood-vessels into the sphenoid sinus, or substance of the bone.

## LXXV.

From this description of the sphenoid bone, it will appear to be of material consequence to

be acquainted with its several parts; for though from its situation it can hardly ever be the subject of any surgical operation, excepting, perhaps, in the single case of tumours growing in the throat and back part of the nose, many of the principal vessels and nerves we have seen pass through it, particularly those which form the chief part of the nose and eye.

In the foetus, the temporal wings can be separated from the body of the bone by maceration, and there are also no sphenoid sinus.

## LXXVI.

*Face.*

Such is the general structure of the cranium, from which we descend to examine the remaining part of the head or face.

The face consists of a number of small pieces, having one common appellation of the upper jaw. These pieces have been divided into six on each side, and this division is a consequence of their manner of ossification, having begun in a number of points, and in the end occasioning divisions between them, as they proceed to an ultimate progress.

## LXXVII.

*Bones of the Nose (Ossa Nasi).*

The first of these divisions is what is termed the ossa nasi, which are two bones outward and convex, and by their junction forming a strong arch. They are thin condensed plates, without any inter-

vening cancelli. Their flat rough edge is laid upon the similar edge of the frontal bone. The nasal process of the upper jaw bone incloses them in a particular way, so as to prevent their being forced in, and their rough lower edge gives a firm attachment to the cartilaginous parts of the nose; the junction of which with the bone, forms the prominent point termed its bridge, often the seat of luxation from injury.

The connexion of this bone to its fellow, is by the anterior nasal suture.

#### LXXVIII.

##### *Nail Bone (Os Unguis).*

The next division, or os unguis, was formerly noticed as a part of the ethmoid bone, but anatomists have generally considered it as a separate part, and agreeable to that idea it may be described as a flat bone, the thinnest and most brittle of any in the body, named from its size and shape, as resembling the nail. Its situation is the inner and forepart of the orbit or angle of the eye, and contiguous to the top of the nose. Its surface is hollowed by a large groove for lodging the lacrymal sac and duct. On the part of the bone behind the groove the eye rolls, the groove occupies the end of it, and the other side of the groove is formed by the nasal process of the jaw bone. From the delicacy of this bone it is easily broken, and as easily perforated in the operation for the fistula lacrymalis, the success of which depends on keeping

the perforation forward so as to enter the nose. This bone is connected to the frontal bone by the transverse suture, to the os planum by the ethmoid suture. Internally it is connected by the ethmoid cells.

## LXXIX.

*Superior Maxillary Bones (Ossa Maxillaria Superiora).*

The superior maxillary bones follow in the order of demonstration. They form the foundation of the face, and affect equally its size and shape. Their upper branch composes the side of the nose. Backwards their flat expansion forms the roof of the palate, and below their projecting circle goes to the sockets of the teeth, or alveoli. The cavity of these bones internally is considerable. By its size it moulds the form of the face, and is capable of containing a pretty considerable portion of fluid, not less than an ounce.

## LXXX.

These bones, as well as by their internal cavity, are distinguished also by their numerous processes.

1. The 1<sup>st</sup> of these is the nasal process, which rising upwards, forms the inner part of the orbit and the side of the nose. and by its outward arch, gives the nostrils shape. To this process the nasal cartilages are appended, and the bones of the nose are supported by its sides.

2. The 2<sup>d</sup> is their orbitary process, or the roof of that cavity which forms the antrum maxillare, and on which the eye rests. In this part is a groove for the site of the principal branch of the

upper maxillary nerve, which here from its situation under the eye, (for it passes out by the infra orbital hole of the cheek bone,) is named the infra orbital nerve, and in its progress it forms the chief nerve of the face.

3. The 3<sup>d</sup> process is that scabrous or unequal ragged surface which connects it with the cheek bone, and which, from its rise, is named the malar process.

4. The 4<sup>th</sup> process is the alveolar arch for lodging the sockets of the upper teeth. It is thin and spongy, is generated with the teeth, and decays, or is absorbed, soon after them. It closely invests the teeth, so that they are incapable of being removed from it without force, and then from its thinness, the alveolar process is generally broken.

5. The palate process is the next in order, or that which composes part of the roof of the mouth, and the bottom of the nose. The middle of this part is a thin plate, which gradually becomes thick as it approaches the alveolar process; and this thin plate is joined to its fellow by a broad flat surface, conspicuous on their separation, but binding them so firm, that they are with great difficulty disjoined. By this surface also a sharp ridge or spine is formed towards the nostrils, which is termed the nasal spine; and on this ridge the edge of the vomer is placed, so that it contributes to form, in some degree, the septum of the nose. Along these bones a great number of

small holes are conspicuous, which give entrance to vessels for their nourishment; and the membrane of the palate is fixed to the bone by very rough tubercles and small threads, which still adhere even in its dried state.

6. The antrum or cavity of the jaw-bone is a part of considerable importance, and requires a separate description. It is situated under the orbitary plate, and above the large dentes molares, so that the former makes its upper partition, the palate plate incloses it below, and the cheeks are its boundary on the sides. This cavity in its shape is concave to the cheek, flat towards the nose, and divided from the nostril by a thin plate or partition, on which the lower spongy bone is hung, and over it is expanded, in the recent subject, a membrane that leaves only a small hole or two into the nose, a structure intended, no doubt, to assist more effectually the organ of sound. The same lining that covers the nostrils, extends also over the antrum, and forms a secreting surface for the separation of mucus, which under irritation becomes morbidly changed and increased.

#### LXXXI.

From this general structure and processes of the maxillary bones, we come to detail their openings or holes.

1. The first is the *Supra orbitary hole* formerly noticed, as being under the margin of the orbit,



and giving passage to the second part of the fifth pair of nerves, and also to a branch of the internal maxillary artery. Sometimes instead of one there are two small holes.

2. The next opening is the *palate hole*, or foramen incisiorum, behind the fore-teeth, and common to both bones below, but proper to each above. This hole can receive the end of a quill. It is filled with a process of the soft palate, and with small vessels and nerves which run between the membranes of the mouth and nose.

3. The last opening, though not entirely proper to this bone, is the posterior palate hole, formed in the back part of the palate, in the division between the palate bones and the jaw bones, as the former is on the fore part of the jaw bones. It is equally large as the former, and serves for the transmission of a large branch of the upper maxillary nerve, to be distributed on the palate.

### LXXXII.

The whole surface of the antral part of these bones is every where perforated for the passage of vessels and nerves to the teeth.

The connexions of these bones with the surrounding ones are numerous. To the parietal bone they are made by the transverse suture; to the os unguis by the lacrymal suture; to the

cheek bone by the external orbital future; to the os nasi by the lateral nasal future; to the os planum by the ethmoid future; and to each other by the longitudinal palate future. In the foetus there are only six sockets for the teeth, there is tuberosity, and the maxillary opening or sinus is only beginning to form.

### LXXXIII.

#### *Cheek Bones (Offia Mala).*

The cheek bone is a large square bone, situated in the outer part of the cheek, the external surface of which is convex and smooth, and the posterior surface hollow for lodging the temporal muscle.

### LXXXIV.

This bone is divided by anatomists into four distinct processes.

1. The 1<sup>st</sup> is the upper orbital process, forming part of the outside of the orbit, or outer corner of the eye and the edge of the temple.

2. The 2<sup>d</sup> is the lower orbital process opposed to the former, and forming part of the lower edge of the orbit, and the edge of the cheek.

3. The 3<sup>d</sup> is the maxillary process, forming the under part of the prominence of the cheek, having a broad rough surface, by which it is joined to the upper bone of the jaw.

4. The 4th is the zygomatic process, forming part of the arch over the temporal muscle, passing outwards and backwards for this purpose,

#### LXXXV.

To these parts may be joined the internal orbital plate, forming the outer and fore part of the orbit.

No holes of importance pervade this bone but for its own circulation. It is connected to the parietal and sphenoid bones by the transverse suture, and to the temporal bone by the zygomatic suture.

#### LXXXVI.

##### *Palate Bones (Osse Palati).*

The palate bones are small, and from their situation and use, would appear as an addition or lengthened space to the maxillary bones for extending the surface of the palate, and completing the nostrils. Their parts are numerous, and their connections uncommon.

#### LXXXVII.

1. The 1st process of these bones is that from which they derive their name. It is of an oblong form, and composes the back part of the osseous palate, lying horizontal with the palatal process of the jaw bone. This part is thin at its middle, and turns thicker at each end. It has a rough or ragged surface, and where it joins its fellow, it forms the middle palate suture. Where it joins the

jaw bone at its palate process, it makes the transverse palate suture. From their junction the palate bones proceed backwards, so as to terminate in an acute point; and on each side of this point they make a semicircular line, which ends in two other points behind the molares of each side.

The velum palati forms a small curve or arch, in the middle of which hangs the uvula or pap, and also its muscle takes its origin from the same middle point.

2. The next process of this bone is the pterygoid, or where behind the last grinding teeth it touches the same named process of the sphenoid bone, immediately before which is also the pterygoid, or third palate hole.

3. The nasal plate, the 3d process, forms a portion of the side of the nose, and antrum maxillare. It is thin, and rises upwards from the palate.

4. The enlargement of the nasal process into an irregular knob, as it enters the orbit, has given it the term in this situation of the orbital process, which is sometimes considered as double. This knob is triangular in shape, is very small, and at the same time deep in the socket.

5. The orbital process of the palate bones, from being cellular or cavernous, joins, from its situation and connection, the cells of the sphen-

noid bone, and thus, by intermixing, they constitute but one cavity.

### LXXXVIII.

#### *Inferior Spongy Bones (Ossa spongiosa inferiora).*

The inferior spongy or turbinated bones are the next in the structure of the face. They are distinct from the upper or ethmoid ones, and only slightly united with the upper jaw bones. These bones in their figure are triangular, and spongy or convoluted in their appearance. They are situated in the lower part of the nose, and their projection forms that point accessible to the finger in picking the nose.

### LXXXIX.

The processes of these bones are two at their upper part. The anterior forms part of the lacrymal groove, and the posterior part of the side of maxillary sinus. They are covered by the same general lining or sensible membrane that pervades all those parts; and on removing it, they appear hung by a small hook to the edge of the antrum maxillare, with one end turned toward the opening of the nostril, and with the other pointing backwards to the throat. They seem to have little share in the organ of smell. Though the number of these bones is generally but two, yet a double pair is at times met with.

## XC.

These bones are connected to the ossa maxillaria, ossa palati, and ossa unguis, by a distinct future in young subjects, but in age they become firmly attached by a union of substance to these bones. •

## XCI.

*Vomer.*

The last of these small and irregular bones, concerned in the formation of the face, is the Vomer, a thin slender one, dividing the two nostrils, and named from its figure, as resembling a ploughshare. It is frequently bent to the one side, enlarging one of the nostrils more than the other. It is composed of two plates, thin, compressed and transparent; but separated at different parts of its edge.

## XCII.

The conspicuous parts of this bone are,

1. Its base or upper part, where, by a wide groove, it receives the projection of the ethmoid and sphenoid bones connecting it to the skull.
2. Its lower part where, by a narrow groove, it receives the rise in the middle of the palate plate, and where the palate future is formed.

## XCIII.

This bone is kept firm on all sides by the support of the other bones with which it is con-

ned, and which are received into its grooves or furrows, and also by the general lining or covering which embraces it and all the contiguous parts.

#### XCIV.

To finish the structure of the face, it remains to examine the under jaw. This consists of one bone which has received various comparisons as resembling the Greek *v*, and as resembling a horse's shoe, or crescent. In the upper jaw, as in the cranium, we have found a considerable number of bones, by which means the ossification beginning at a considerable number of points, is sooner completed, and the irregular shape it presents at the same time formed. The risings of the bone, also has the effect of protecting the orbits, enlarging the face, giving attachment to the muscles, and serving other important purposes. In the lower jaw the structure is more simple, but its description\* is rendered complex by the variety of parts with which it is surrounded, and to which it gives attachment.

#### XCV.

The different parts of the jaw itself that deserve enumeration, are,

1. The chin, extending between the mental holes or foramina, distinguished, if well formed, by the squareness of its shape.

2. The base of the jaw, terminating by its straight even line the outside of the face, and reaching from the point of the chin to the corner of the jaw. Fractures of this part are known by the depression or its receding from the even line.

3. The angle of the jaw is the back part of the base or the corner where it ends, and the bone rises upwards to form its connection with the head.

## XCVI.

The processes of the jaw, equally important as these divisions of it described, are,

1. The coronoid process, so termed from its horny appearance, having its sides flat and turned up acutely with a sharp point. This process forms the place for the insertion of the temporal muscle, and it is situated therefore behind the zygoma or arch under which the temporal muscle runs. This muscle embraces the coronoid process on all sides, and from the position of the process before the articulation, an additional strength is given to the action of the muscle, while externally, from this state of the surrounding parts, the process cannot at all be felt.

2. The condyloid process behind the former, is the proper articulating one of the jaw. It is like the former, flat, and arises from the body of the bone turned up at its angle. It has a smooth cartilaginous surface, placed upon a cervix at the upper and back



part of the bone. It is received into a long hollow of the temporal bone, just under the root of the zygomatic process. By its exertion it acts entirely the part of a hinge, though of a peculiar kind, and admits only that degree of motion which is necessary in the grinding of the food.

3. The alveolar processes of this jaw resemble those of the upper one. As the rest of the body grows, they lengthen in proportion, and receive a greater number of teeth. When fully grown and expanded, their sockets are also completely filled; and when their sockets become emptied by the gradual fall of the teeth, the processes that received them become absorbed, and are carried away. The jaw then alters in size, becoming narrower and more prominent.

#### XCVII.

The holes or openings of the under jaw come next in order.

1. The  $1/2$  is the great hole for admitting the lower maxillary nerve, and corresponding blood vessels, into the hollow of the jaw, where passing round within its circle, the nerve gives branches to the teeth. The situation of this hole is the inner side, at the point or root where the coronoid and condyloid processes part. Its passage is defended by a small pike at its entrance, and a groove or furrow conducts downwards to the hole.

2. The 2<sup>d</sup> opening is the mental hole, formerly noticed on the side of the chin, or about an inch from its point. Through this hole the remains of the former nerve, or what part is not expended on the teeth, passes out on the chin.

## XCVIII.

The surface of the lower jaw is every where remarkably hard, and within it has numerous cells. It has also a canal below the roots of the teeth, which communicates with the maxillary cells, at the forepart of the bone.

In the fœtus the lower jaw is composed of two pieces joined together in the middle of the chin by the intervention of cartilage, which gradually ossifies, and leaves no mark of division. The cavities of the teeth are also in the same state as in the upper jaw. Luxation of this part is apt to happen by opening the mouth too wide, and occasioning the condyles to slip forward on the zygomatic process.

## XCIX.

Having now examined the first division of the body, or the head in its separate and connected state, descending downwards, we proceed to the trunk.

## C.

The trunk is divided by Anatomists into three parts, the spine, pelvis, and chest, or thorax.

*Spine.*

The *ist* or spine is that column which extends from the condyles of the occipital bone, to the end of the os coccygis. Its name is derived from the projecting points of its bones, which form a continued ridge, as if but one whole. In this ridge is contained the spinal marrow protected from injury, while the weight of the head and other parts is at the same time thrown upon it, and obedient to every motion and flexion of the body, it yields readily to the weight and pressure, to which it is thus subjected. Nor does this last interrupt the freedom of its motion, or weaken its powers of affording support. Equal to every exertion required, it forms a complete defence to the delicate parts entrusted to its covering.

## CI.

The separate pieces of the spine are termed *vertebræ*, from their power of motion or turning. They are twenty-four in number, and the figure their united mechanism displays, differs according to the particular point of view in which it is taken. Thus when viewed anteriorly or posteriorly, the column appears straight, when again in a lateral direction, it seems curved; so as to resemble, in some manner, the Italic letter *S*. Superiorly it is drawn backwards by muscles, and formed into a curve for supporting the *æsiophagus*.

178.101



178.101



In its middle it is also incurvated backwards to contain the heart and lungs; afterwards it is bent forwards to contain the abdominal viscera; and again it goes backwards to enlarge the pelvis.

## CII.

The twenty-four vertebræ of the spine have been arranged into three divisions, those of the neck, the back, and loins.

The 1<sup>st</sup> are seven in number, free and loose in their motions, simpler than the rest in their structure, and with little or no projecting points.

The 2<sup>d</sup> are twelve in number. They are big and strong, each locked into its fellow by their processes being laid over each other. They are likewise steadied by their junction with the ribs, which considerably limits their motion.

The 3<sup>d</sup> are five in number; the largest and strongest of the whole, and sustaining the whole pressure and column of the body. Their processes are wide and disengaged, which enables them to perform whatever motion is required.

## CIII.

Besides this division into vertebræ, the spine has also been considered as consisting of two pyramids, the upper and under one. The upper, the long one, is composed of vertebræ or bones, which turn on each other. The under, the short one, is composed of false vertebræ, or bones which at an early

period of life, resemble the true vertebræ, but afterwards grow together, so as not to contribute to the motions of the trunk of the body. These pyramids are joined together by their bases.

#### CIV.

Though the regular vertebræ of the spine are twenty-four in number, which they do not exceed, yet the proportion of them to its separate divisions sometimes varies according to the varying proportion of the body. Thus, where the loins are long, six instead of five vertebræ may belong to them, and only eleven be left for the back. In the same way, where the neck is short, the back may come to have thirteen pieces; and again, if the neck is long, it may have eight pieces, and the back but eleven.

#### CV.

All the vertebræ agree in their general structure, and as this structure is most conspicuous in the largest, we shall examine one belonging to the loins.

Every vertebra consists of two leading parts, its body and its different processes.

#### CVI.

The body of the vertebræ is that firm part for giving support to the weight of the body, with an internal cavity for the passage of the spinal marrow,

with two processes above and below ; by means of which it is articulated with the contiguous bones, with a transverse one for the attachment of the muscles, which turn the spine and a spinous one backwards, forming the ridge which distinguishes the spine, and gives it its name.

## CVII.

The 1<sup>st</sup> part of a vertebra, or the body, is a large spongy bone, of a convex shape anteriorly, and flattened on the sides. Behind, it forms something of a semi-circle, to give a convenient lodgment by its cavity, for the spinal marrow. The covering of this part is thin in proportion to the size and substance of the bone. It is farther tipped with a ring of cartilage above and below, as a means of defence, and into the spherical hollow of this ring is received the ligament that connects it, and the two contiguous vertebræ. By this structure, something like a ball and socket is formed, though not completely. This body forms the principal part of the vertebra. It is that part which gives strength and motion, and its strength appears always proportioned to the weight it receives, and the motion required in it. Thus the vertebræ of the loins, as supporting the whole column, are largest in size, and possess a considerable motion, and the size of the body gradually lessens in each as they advance upwards, the body of the cervical vertebræ being smallest.



2. The 2<sup>d</sup> part of each vertebra is its articulating processes, which are a small oblique projection from its body, having a smooth surface, connecting them to the articulation of the next bone, which is done by means of a ligament or elastic joining, and next by these processes in the common form. From their oblique situation, these processes are at times termed the ascending and descending oblique processes. The former connecting the vertebræ with the one above, and the latter with the one below.

3. Its spinous processes form the 3<sup>d</sup> part of each vertebra, whose sharp edges projecting are the ridge of the back, and give it its name. They rise at the meeting of the arch or cavity for the spinal marrow behind, pointing from its middle, and they give attachment to the muscles that raise and extend the spine, being powerful levers to assist their action.

4. The 4<sup>th</sup> processes, the transverse stand out as arms from the medullary cavity, and from their situation with respect to the spine, are so named. Like the former processes, their use is to give insertion to muscles, and to act like levers in assisting the same purpose, by raising and extending the spine.

#### CVIII.

Such is the general form of the vertebræ, but the peculiarities attached to each individual one,

fall to be examined in the different divisions into which they have been arranged. These peculiarities we shall find adapted to their particular uses.

## CIX.

The vertebræ of the loins are particularly distinguished by the largeness and broadness of their body, by their shortness in respect to the height of their body, by the greater thickness of their intervertebral substance or cartilage, and by their several processes being larger, more distinct, and fitter for the purposes of motion.

## CX.

The vertebræ of the back differ from the former in the greater length of their body, shorter before, and flatter on the sides, and more hollow behind, and in the thinness of their outer cartilage. Their processes also are larger, and more acute. Their spinous ridge is more regularly arranged, and their transverse processes are short, knobby, and more restricted in their motions. Besides which, they are marked by the impressions of the ribs.

## CXI.

The vertebræ of the neck are distinguished by their flat surface before and behind, and by the smallness of their body, which the last of them entirely wants, and which the next also displays of an uncommon form, by their want of a hollow for the reception of the intervertebral substance, and

by some of their spinous and transverse processes being divided or bifurcated.

## CXII.

In stating the structure of the vertebræ, it is to be observed that their transverse processes are perforated for the transmission of the great vertebral artery through them. The protection of this artery by such a channel, seems of great importance; for as there are only two that go to the head, it and the carotid, the former supplies the place of the latter, in cases of obstruction or disease.

## CXIII.

The two first of the cervical vertebræ, by differing from all the rest in their immediate connection with the head, display also a difference of structure for this purpose, which claims a more minute investigation.

The 1<sup>st</sup> is named Atlas, as giving the immediate support to the globe of the head: the 2<sup>d</sup>, Dentatus, as forming the axis on which it moves.

## CXIV.

The Atlas has no body, but instead of it a small arch, and it may be considered as little more than a single ring, with a flat surface backwards, polished by the motion of the tooth-like process of the next bone. It possesses, however, the articulating processes, and there is a sharp point, rising perpendicularly upwards towards the occipital bone, to which it is held by a strong ligament.

Upon either side, where the mark of the tooth-like process of the dentatus is conspicuous, a small point projects, between which the transverse ligament is extended, and then it divides the ring into two openings, one giving lodgement to the tooth-like process of the dentatus, the other to the spinal marrow, and the rupture of this ligament no longer confining the tooth-like process, allows it to injure the spinal marrow, and thus death is often produced. The only thick part of the atlas is its articulating processes, which are in the middle of each side of the ring, and its oval smooth surface is joined upwards to the occiput, and downwards to the 2d vertebra. The form of these processes on their upper division is oval, somewhat hollow, and also oblique. By this means a nodding motion of the head is only permitted by them, and the rotatory motion is made by the conjoined action of the head and atlas turning on the tooth-like process of the dentatus. The surface of the atlas above is somewhat hollow, to secure its connection with the head; and below again it is smooth, to facilitate its motion. The hole or perforation of its transverse process gives passage to the vertebral artery which makes an impression or hollow upon the ring.

## CXV.

The 2d vertebra, or the dentatus, derives its name from the tooth-like process, or projecting

point, on the upper part of its body. The figure of its body is conical, and this part of it is proportionally longer than any of the rest of the vertebræ, and the opening through it for transmitting the spinal marrow is of a triangular form. Its spinous process is also thick and strong, to give origin to the muscles which assist in the rotation and extension of the head, and it is turned downwards to allow these motions to be more readily performed. Its tooth-like process is thick, long, and pointed; and from this point proceeds upwards the ligament that ties it to the hole of the occipital bone. Near its root appears also the smooth collar or neck on which it turns, encompassed by the ring of the atlas, so as to lock it as it were in its place. On each side of the tooth-like process are situated like shoulders, its articulating surfaces.

## CXVI.

Having thus examined the general structure of the vertebræ, and particularly that of the two first, we are next led to consider the common opening they form for the transmission of the spinal marrow, and its branches in their distribution through the body.

## CXVII.

*Spinal Opening.*

This opening is of a nearly rounded form, and to render its cavity safe for the lodgement of these

delicate parts, it is every where lined with strong coverings. The outermost encloses the marrow by forming a sheath or membrane round it, and it makes also the strong ligament by which the separate bones are connected to each other. As the medullary substance descends, it regularly distributes branches to every part, and from the interstice of each vertebra, a branch or a nerve is sent out on each side, which rating two for each of the twenty-four vertebræ, makes forty-eight in all, and their passage takes place by an opening through the sheath or membrane, when they proceed under the articulating process at the interstices of the vertebræ.

### CXVIII.

#### *Intermediate or Inter-Vertebral Cartilage.*

The inter-vertebral substance is a peculiar species of cartilage, of a soft pliant nature, and of a particular folded structure, endued with wonderful strength and elasticity. It lies attached to the forepart of each vertebra, and is confined by means of a connecting ligament all round. This cartilage yields exactly to the motions of the body, and returns on any alteration of motion back to its place. By this structure it is fitted for allowing all the regular exertions of the spine, without injury. It endures compression, and yields under its burden; so that by the continued pressure on it in the day, we are an inch shorter

at night than in the morning. The same remark applies to its change in the progress of life, for in age by its yielding, the spine bends forwards; and at any period by a particular position increasing the pressure on a particular part of it, the inclination of the spine may be directed that way; and even extended in its effects to the vertebræ themselves. From this cause arise those distortions that happen in children and young people from tambouring, from disease, confining to a particular posture, from carrying of children on one arm, &c.

### CXIX.

#### *Motions of the Spine.*

The structure of the spine thus described, fits it for the various motions its situation requires, and the extent of these motions is more or less limited in different parts of it. The greatest latitude prevails in the neck, in the back there is almost none, and in the loins it is but confined. In the neck also there is a degree of turning which favors the motions of the head. In the back the motions consist chiefly in bending forward, but in the loins, though limited, still a considerable motion prevails, and the processes here of the vertebræ are disentangled and free, having a very great thickness of intervertebral substance. To perform their motions, each of the vertebræ is furnished with two distinct joints; for,  $1/2$ , the

the intervertebral substance allows their motion to a sufficient degree without interfering with each other ; and 2dly, their articulating processes are of the nature of a common joint.

## CXXX.

*Chest.*

From the spine or back part of the trunk, we proceed naturally to the forepart or chest, the connection between them being formed by the ribs. This part is bounded by the sternum before ; by the ribs on each side, and the dorsal vertebræ behind. By the ribs the figure of the chest is moulded, and they form a covering and defence thrown over the lungs, as well as to assist these organs by their motions in the exercise of breathing.

## CXXXI.

*Ribs.*

Each rib is divided into three parts, its bone, and its two extremities : at the end of its bone towards the vertebræ there is an articulating head and a knob, both to connect it with the vertebræ ; at the other extremity is a pointed cartilage, which is received into a cartilaginous socket, or hollow of the sternum.

## CXXII.

Corresponding to the number of the dorsal vertebræ, the ribs are twelve in number, though like



them they occasionally vary, in some cases there being thirteen, and in others only eleven. The ribs, like the vertebræ, undergo also certain divisions; the seven upper ones from their connection with the sternum being termed *true* ribs, and the remaining five being named *false* ribs, from their having no direct union with the sternum, but by means of a separate cartilage to which they are all connected, except the two last, which possess only a loose attachment to the muscles of the abdomen.

### CXXIII.

In their figure, the ribs display a convex form externally, by which their strength is increased, and internally, they are smooth and concave, having their flat surface turned as a protection to the lungs. This flatness, however, is in some degree irregular, and accommodated to the degrees of elevation in the thorax, so that it may be always preserved in its application to the lungs. The upper edge is also something rounded, while the under one is more of a sharp form, having a groove within it, for the intercostal artery and nerve, where they run protected.

### CXXIV.

In detailing its structure, each rib admits a division, as already noticed, into different parts.

1. The  $1\frac{1}{2}$  is the round knobby head which connects it to the spine, and it is placed in the

interstice between the two vertebræ, not directly against either.

2. The neck of the rib, where it is particularly small and round, placed immediately before the head.

3. The tubercle of the rib, placed about an inch from the head, with a flat surface and irregular edge, to be articulated to the transverse process of the undermost of the two vertebræ, to which the head is joined.

4. The small tubercle at the outside of the former, for the attachment of ligaments and muscles from the spine, which fix and move the rib.

5. The angle of the rib, or the boundary between its round and flat part, where the lateral part of the thorax is formed.

### CXXV.

Such is the general structure of the ribs, but certain peculiarities attend individual ones. Thus the size and length of the ribs suffers a gradual decrease from the first to last, and thus a small opening only takes place at the top of the thorax, while the lower opening equals the diameter of the abdomen. The 1<sup>st</sup> rib is the most crooked, the 2<sup>d</sup> is rounded in the same manner, and the 11<sup>th</sup> and 12<sup>th</sup> are exceedingly small and delicate. The heads also of the first and two last are rounder than any of the others.

## CXXVI.

*Cartilage of the Ribs.*

Like the ribs themselves, their cartilages become also gradually larger, but contrary to what happens in the ribs, they approach nearer to each other in their descent. They form the edge of that cavity, over which the diaphragm has its principal attachment, and make the division between the chest and belly. Like the ribs, the cartilages are flat in their outer and inner surfaces, and smooth where they are opposed to the lungs. In their connection with the sternum, the cartilage of the 3d rib is the only one directly united, those of the 1st and 2d ribs descend to touch it, and those of the 4th, 5th, and 6th, rise up in proportion to their distance from the central point. Each of the first five ribs have separate cartilages, the 8th, 9th, and 10th have theirs connected with the cartilage of the 7th, and the two last ribs are unconnected, and lie loose among the muscles.

## CXXVII.

Thus, by the peculiar junction of the ribs to the vertebræ, and their playing on a soft substance, is attrition from their constant motion guarded against. The tubercle also of the ribs, comes to be more supported by being joined to the transverse processes, and this junction adds also to its security, hinders the head of the rib from starting

out, and regulates its motion, by only admitting that kind of rolling motion, which the ribs possess in respiration. By the greater thickness of the dorsal vertebræ, and consequently, distance of their transverse processes, a greater motion of the lower ribs than of the upper takes place, while from the elastic nature of the cartilages, they are also mechanically pushed back; so that after death, the body is always in a state of expiration.

### CXXVIII.

#### *Breast Bone (Sternum).*

From the ribs or sides of the chest, we proceed to the forepart of the sternum. It is a long square bone lying over the heart, and forming a defence to it, while at the same time it completes the cavity of the chest, and regulates by its support of the clavicles, the motions of the shoulders.

### CXXIX.

This bone varies in its structure more than most others at different periods of life. In the foetus it is composed of seven or eight pieces, which gradually unite, and in age form but one. At manhood it consists of three pieces, one of which is cartilaginous, and it remains so till a very advanced period. It is in this state we are to consider it when its three different pieces are united by cartilage.

CXXX.

The upper or 1<sup>st</sup> piece of the sternum is of a somewhat triangular shape, with its point placed downwards, and its base above somewhat hollowed for receiving internally the root of the trachea, and on each of its upper corners appears the hollow for the seat of the clavicles. Its sides again are occupied by giving insertion to the cartilages of the ribs. Thus in its structure it is thick and broad above, and thin and narrow below, with its outer surface flat, and its inner slightly hollowed.

The 2<sup>d</sup> piece of the sternum is square in its form, and larger than the former, so that on its sides it receives no less than the insertion of eight ribs, there being upon it five distinct pits or indentations, and three joined by cartilage into one.

The 3<sup>d</sup> piece of the sternum is properly a cartilaginous appendage to the bone, and continues so during the whole of life. From its pointed extremity it is named the Xiphoid, or sword-like cartilage. The variations of its form are considerable in different subjects, for instead of the common form, it is sometimes narrow like the point of a small sword, or turned obliquely to one side, or forwards or backwards, forked at the point, or perforated at the middle. Where these variations occasion it to project much in any direction different from the common one, it is attended

with bad consequences, and in one instance the projection is mentioned as having extended to the navel. The point of this cartilage gives also a firm origin and support to the abdominal muscles.

## CXXXI.

*Basin (Pelvis).*

To finish the description of the trunk, it remains to examine the basin or pelvis, being that division which supports the other parts, and connects them with the lower extremities. It may be considered as a strong, wide, bony arch, forming the fixed point for most of the important motions of the body.

## CXXXII.

The pelvis has been so named from its figure or resemblance to a basin, though its figure varies somewhat in different individuals, and it has been occasionally considered as oval, elliptic, and triangular. In the foetus and child it consists of a number of pieces, which in the adult are reduced to four,—the two ossa innominata, the sacrum, and coccyx. The two first forming it anteriorly, and the two last composing it behind.

## CXXXIII.

*The Sacred Bone (Os Sacrum).*

The os sacrum, distinguished also by the name of basilare, forms with its appendage or the os coccygis, the column of the false vertebræ; the

base of which is connected to the base of the true vertebræ, which is considered as terminating at the loins. The sacrum therefore is originally a number of distinct vertebræ lost in the adult, but still visible by the marks or lines of their former separation, which wanting now the character and motion of vertebræ, are no longer entitled to the name. In the same manner as the other vertebræ, they possess also holes for the transmission of nerves; and their rough and irregular surface on the back corresponds to the spinous processes of the other vertebræ.

## CXXXIV.

In its shape, the sacrum is triangular, with its base attached to the spine. Its anterior surface is concave for enlarging the capacity of the pelvis, and smooth and flat, to permit the head of the child to pass without injury. Its posterior surface is rough, irregular, and spinous, for the attachment of large muscles to give figure and strength to these parts. With this figure, the sacrum in proportion to its size is the lightest bone in the body, and the most spongy and cavernous in its texture. Hence it requires the strong covering of ligaments and muscles to defend it from injury.

## CXXXV.

Like the other vertebræ, the sacrum possesses a triangular cavity, which is a continuation of the medullary opening; and this cavity contains the

termination of the spinal marrow; which, from being here branched out in a particular manner, is termed the cauda equina. The nerves arising from it pass through the great holes on the fore-part of the bone, and the three first of these holes give exit to the branches which with the last of the loins compose the sacrosciatic nerve that supplies the lower extremities, and is the largest in the body: while the two lower holes are occupied by the nerves that supply the pelvis.

The holes on the back of the sacrum give also passage to the small nerves of the hip and loins, though their opening is too considerable for this purpose alone.

## CXXXVI.

This bone forms a connection at every point of its edge with other bones. Above it is joined to the last vertebra of the loins, and the projection formed by these two anteriorly, is termed the promontory of the os sacrum; below, it is attached to the coccyx by a sort of joint, moveable in men till 20, and in women till after 40. On each side it receives the deep indented rough surface of the haunch bone into its own surface, and this junction is rendered strong and immoveable by the attachment of strong ligaments and muscles.

## CXXXVII.

*Rump Bone (Os Coccygis).*

The os coccygis, or continuation of the sacrum,



is so named from its resemblance to the beak of a cuckoo, and forms an acute point for the termination of the spine. At birth it is entirely cartilaginous; in the progress of childhood it is gradually forming into bone, and between its separate pieces the interposed cartilage continues long visible, and allows a degree of motion particularly between the first and second piece. In its figure, this bone is roundish or broad, and flat above, and tapering below. Behind it is convex, and forms a curve forwards which supports the end of the rectum, and contracts the lower part of the pelvis. It consists of four distinct pieces in young subjects, though they are sometimes reduced to three, and one of them is considered as belonging to the sacrum. It possesses no cavity, nor does it transmit any nerve or vessel.

## CXXXVIII.

*Nameless Bones (Ossa Innominata).*

The ossa innominata, or nameless bones, so termed from their irregular shape, fill up the sides and forepart of the pelvis. In the child they form three distinct parts, and this distinction is generally preserved in their description. These parts are the ilium, ischium, and pubes.

## CXXXIX.

*Haunch Bone (Os Ilium).*

The ilium or haunch bone constitutes the upper and largest part of each os innominatum; and

spreads out to assist in supporting the contents of the abdomen. On it also lie the strong muscles of the thigh, and it forms the rounding of the haunch. It is divided into two principal parts, the flat upper part named its ala, and the lower rounder part termed its body.

## CXL.

The ala or wing is distinguished into several different parts, for

1. Its whole circle is edged with a firm ridge of bone, which originally in the child is a distinct cartilage. This ridge is termed the spine, and gives attachment to the lower oblique and transverse abdominal muscles.

2. Its spinous processes, which are four abrupt points, two at its fore and two at its back part, the former give attachment to the rectus muscle of the thigh, and to the glutæus muscle; the latter are less considerable, consisting merely of two rough projecting points near its articulation with the sacrum, which serve partly for the origin of muscles, and partly to give a firm insertion to the ligaments which fix this joint.

## CXLI.

The back of this bone is covered by the great glutæi muscles, and the costa or inner concave surface gives origin to the internal iliac muscle. The surface of this bone is broad and rough; and

in the form of its connexion with the sacrum, it is impossible that motion can take place.

The nameless or acute line, which runs upon the internal surface of the bone, divides the ala or wing from the socket, or forms the lateral part of the brim of the pelvis, and the line of division between it and the abdomen.

## CXLII.

### *Hip Bone (Os Ischium).*

The ischium, or hip bone, is the lowest part of the pelvis, and is placed perpendicularly under the os ilium. It is the part on which we sit, and forms the largest share of the socket for the head of the thigh bone. The figure of this bone is irregular, and it is divided into three parts into the body; the bump or tuberosity, and the ramus or branch.

The body, or the upper thick part, forms near one half of the socket for the thigh bone, from its upper part it sends backwards the spinous process for the attachment of muscles and the sacrosciatic ligament.

The tuberosity, or round knob, is that part on which the body rests in sitting. It is remarkable as giving attachment to the inferior sacrosciatic ligament, and to the greater part of the flexor muscles of the leg. This bone forms also a mark for the surgeon in directing his incision in litho-

tomy, by making it in the middle between the anus and this bone.

The branch or ramus of the ischium goes obliquely upwards and forwards to be connected with the pubis. Its edges, from being turned a little forwards and backwards, form the one the arch of the pubis; and the other, the thyroid hole. This part also gives attachment to a number of muscles.

### CXLIII.

#### *Share Bone (Os Pubis).*

The os pubis, or share bone, is the smallest division of the innominatum. It takes its name from being covered with the mons veneris, the hair on which part marks the age of puberty. It forms on each side the anterior portion of the pelvis, and is distinguished into its body, its angle, and its branches. Its body, or superior part, is thick, strong, and forms the upper and forepart of the acetabulum. Its part of the socket is both small and shallow, but the bone grows broad and flat as it approaches the symphysis. Over the middle of the bone pass out of the pelvis, the iliac and psoas muscles, flattening its surface where they run. The angle, or symphysis, is that part of the pubes where, by the intervention of a cartilage, its portions from each innominatum are joined, or constitute what is called its arch. At the very spot of the joining, as the

bones rise a little higher, this is termed the crest of the pubes, and from it the small pyramidal muscles of the abdomen rise. The branch or ramus of the pubes is that part which, with the branch of the ischium, composes the foramen ovale, or edge of the thyroid hole.

## CXLIV.

*Extremities.*

From the trunk which we have now examined, we are led to the remaining part of the structure, the extremities. They are divided into the superior and inferior; the latter of which, as being connected with the pelvis, we shall first describe.

## CXLV.

*Inferior.*

The inferior extremities are composed of the thighs, legs, and feet.

## CXLVI.

*Thigh (Femur).*

The thigh bone is the longest in the body, and the thickest and strongest of the cylindrical bones. It supports the whole weight of the trunk, and that chiefly on its head, though placed in an apparently unfavorable direction for this purpose. Indeed one thigh bone frequently does this itself. The thigh bone is very regular in its structure. It is divided into

1. Its body, very thick, bent forwards, and of a roundish form above, but somewhat triangular

about its middle. By this bending, greater power is given to the action of the muscles. It is the effect of original formation for this purpose, and it takes place in various degrees in different persons.

2. Its head or ball, which is smooth, covered with cartilage, and forming almost two thirds of a sphere. It is received into the deep socket formed by the acetabulum of the os innominatum; and to render its joint stronger, its socket is both lined with cartilage, and the joint is also strengthened by the round ligament, which shows a rough pit, at the under and inner part of the ball.

3. The neck, which is much longer than that of any other bone, being an inch and half in length, and passing obliquely downwards and outwards from the ball, to allow a free motion of the body of the bone in various directions; and, by its length, its head is more fully fixed in its socket; and, by its width, its motions are allowed to be free and unembarrassed by the pelvis. The trochanters placed on the neck, are the largest processes in the body for the insertion of muscles, receiving their name from their office of turning the thigh. The first of them, placed at the outer part of the neck, is that great bump so plainly felt by applying the hand on the haunch; and serves for the insertion of the glutæi, and all the

large muscles that serve for the outward motion of the thigh. The second arises on the inner side of the bone, lower than the former, and serves for the insertion of the flexor muscles of the thigh, or those that bend it towards the body. Between the two trochanters is a rough line for the insertion of the capsular ligament, being the commencement of the next part, the *linea aspera*.

4. The *linea aspera*, or ragged ridge on the back of the bone, extends to its lower part, and gives attachment to numerous muscles which pass from the pelvis to the thigh, and from the thigh to the leg. This line is single in the middle, and is forked at each end, as it passes to the condyles.

5. The condyles are the two bumps into which the bone swells at its lower part; they are divided into the internal and external condyles. The internal is larger and deeper than the external, to compensate for the obliquity of the thigh, and to give less obliquity to the leg. Betwixt the condyles is placed the cartilaginous pulley at the forepart of the bone, with its outer surface higher than its inner one, to be adapted to the motion of the patella. On the back part, between the condyles, is situated a deep notch, which contains the great vessels and nerve of the leg. Below the middle of the bone there is a passage for the medullary vessels, and small arteries enter through its porous extremities.

## CXLVII.

On this structure of the thigh bone, it may be observed that the security of its joint is particularly guarded by the deepness of its socket; and the neck stands wide in order to allow a free motion of the joint. The trochanters are next formed large, that they may give a proper insertion to the muscles. The body of the bone is thick and strong, capable both of supporting weight, and bearing the action of the muscular powers applied to it. By the swelling of the condyles, a broad surface is afforded for its junction with the knee.

## CXLVIII.

*Leg.*

The leg is composed of three bones, the tibia, fibula, and patella.

*Tibia.*

The tibia is situated at the inner part of the leg, and derives its name from its resemblance to a trumpet, expanded at top, and circular below. Its junction with the thigh is peculiar, its bone being merely appended to the former, and secured by ligaments, the number of which exposes it to disease.

The tibia is divided into

1. Its upper end, forming a large head, which is thick and spongy, and is divided on its upper surface into two superficial cavities, which are imprest



as it were by the condyles of the thigh bone. Between these cavities there rises a rough protuberance or high ridge, pitted on its fore and back part for the attachment of the anterior and posterior crucial ligaments. On the upper and fore part, there is also a tubercle for the insertion of the lower tendon or ligament of the patella. In addition to this, there is also observable, under the outer edge of the head of the bone, a cartilaginous or articulating surface, like a slight dimple for the connexion of the thigh bone with the head of the fibula; and this connexion is of the slightest kind, being merely laid upon it.

2. The body of the tibia displays a triangular form, and its acute angles run along its whole extent. The anterior angle, called the spine or shin, is a little waved, and extends from the tubercle to the inner angle; and at the head of this ridge is situated that tubercosity, into which is inserted the ligament of the patella. Through its whole extent, this line can be traced through the intermediate substance. The 2<sup>d</sup> angle is turned directly backwards, and is less acute than the former; and the 3<sup>d</sup> one is turned towards the fibula, to receive the interosseous membrane that connects the two bones.

3. The under head of the tibia forms the principal share of the ankle joint. It is smaller than the upper head, corresponding to the different size

of the two joints of the knee and ankle. Its projecting or pointed part constitutes the inner ankle, and the outer ankle is composed by the lower end of the fibula applied upon a hollow or femilunar cavity of the tibia formed to receive it. The front of the tibia forming the inner ankle, even protrudes beyond the joint, and serves in a certain degree as a guard to it.

## CXLIX.

The tibia is one of the largest and strongest bones in the body, and is necessarily so, in order to support its whole weight, which it does without any assistance from the contiguous bone or fibula. Externally, its substance is thick, and its plates are firm and strong. Internally, it is cavernous and cancellated. It derives also additional strength, both from its general form, as well as from its ridges. Its ankle processes are so directed as to give an obliquity to the foot, a circumstance much studied both in the situation of the bone here, as well as the soft parts.

## CL.

### *Fibula.*

The fibula may be considered as an appendage to the tibia, chiefly for the purpose of forming the ankle joint. It is a long slender bone, the most so of any in the body, and is a useful support to the tibia in cases of its fracture or disease.

The fibula in its shape is triangular, and has two knots, one at each extremity. The upper one, or the loose head, has a superficial smooth cavity towards its inner side, to be articulated with the tibia, where it is tied by ligaments of such strength, as to allow very little motion; and in this way is its want of strength, in its connexion with the bone, compensated by its close circumjunction with ligaments.

Its under knob, or head, is chiefly employed in making the outpart of the ankle joined with the end of the tibia. On the inner side it is enabled to form such a connexion with the bones of the foot, that a complete hinge is composed, firm and strong, and capable of every motion. Thus the fibula forms a necessary addition to the leg by giving additional strength to the tibia, by allowing a more extensive insertion of its muscles, and supporting the tibia when affected by disease. Its chief use however is, the share it possesses in the formation of the ankle.

#### CLI.

##### *Knee-Pan (Patella).*

The patella or knee-pan, completes the structure of the leg. It is of a triangular flat shape, the anterior surface of which is convex, and perforated by numerous holes for the insertion of tendons and ligaments which cover it. The posterior surface is smooth, and divided by a longitudinal

prominent ridge into two cavities. Into the upper point of the patella or basis of its triangle, is inserted the four great muscles that extend the leg. The lower extremity of the patella is tied down by a ligament attached to the tubercle of the tibia immediately under the knee, and by which it is so firmly restricted as to appear but a part of the tibia.

The use of the patella is chiefly to extend the power of the muscles of the leg, by moving their direction farther from the centre of motion in the manner of a pulley. Thus when the knee is at rest, the patella sinks down into the hollow of it; and when the muscles begin to act, it gradually rises up so as to increase their power. It also serves to defend the articulation of the knee from external injury.

## CLII.

### *Instep (Tarsus).*

The tarsus or instep, is composed of seven bones, by which is formed an arch, possessed of a proper firmness and elasticity to support the body. These properties it derives from the number of pieces of which it is composed, and from the strong junction of these pieces by proper ligaments.

The first bone of the tarsus is termed the astragalus, which, by its union with the bones of the leg, forms the joint of the ankle.

The 2d is the heel bone, (*Os Calcis*,) or end of the arch that supports the body.

The 3d is the boat-like bone, (*Os Naviculare*,) which connects the three small bones with the first.

The 4th is the cuboid or cubical bone, (*Os Cuboides*,) that joins also the small bones to the heel bone.

The remainder are the small bones themselves, of a wedge-like shape, termed therefore cuneiform, immediately occupying the seat of the shoe-buckle, and giving attachment to the next division of the foot, or metatarsal bones.

### CLIII.

#### *Astragulus.*

In describing the tarsal bones, the astragulus is the most important. Its smooth head is received into the scaphoid cavity of the tibia; and by its connexion it forms a pulley possessing an extensive motion.

This motion, however, is only forwards and backwards, and it is facilitated by the smooth arched surface of the bone, covered with cartilage and lubricated. The sides of the bone are also plain, smooth, and covered with cartilage. Its under part consists of a deep fossa or depression, which divides it into an anterior and posterior articulating surface. The latter of these is large

and concave, and by it, it is connected with the upper and middle part of the os calcis.

The former is irregular and convex, where it plays upon two smooth cavities at the inner and forepart of the os calcis, and upon a cartilaginous ligament, extended between it and the os naviculare.

## CLIV.

*Heel Bone (Os Calcis).*

The heel bone, or os calcis, is large and irregular, and is the end of the arch of the foot. From the rough point of it, on which we stand, proceeds the tendon Achillis; and by this roughness, a firm insertion is given to it. Next to this point of insertion of the tendon, is its irregular articulating surface for its connexion with the astragalus. A 3<sup>d</sup> articulating surface, or posterior prominence, attaches it to the os naviculare; and a sort of arch, or large cavity downwards, gives passage to the tendons of the long flexors of the toes, and to the vessels and nerves of the sole of the foot.

## CLV.

*Boat-like Bone (Os Naviculare).*

The boat-like bone, or os naviculare, is situated at the fore part of the astragalus, and inner part of the foot. It is a flattened circular body, with rising borders, and its posterior surface receives the head of the astragalus in the manner of ball

and socket. Its anterior convex part receives the three cuneiform bones, and is divided as it were into three articular surfaces for this purpose.

# CLVI.

## *Wedge-like Bones (Ossa Cuneiformia).*

The wedge shaped bones, or ossa cuneiformia, form the fore part of the tarsus, and are placed at the inner side of the cuboid bone. They are laid to each other like the stones of an arch. Their upper part is flat where they are covered with ligaments, while their under part is irregular for the attachment of muscles and strong ligaments lying in the sole. Of the three bones, the least is placed in the middle, the largest is appended to the great toe, and the middle sized one is appended to the metatarsal bone of the third toe, and joins also the os cuboides.

# CLVII.

## *Cuboid Bone (Os Cuboides).*

The cubical bone, or os cuboides, placed at the fore and outer part of the tarsus, is next in size to the astragalus. It joins the last cuneiform bone and the os calcis, between which it is wedged, and forms as it were an arch within an arch, increasing both the strength and elasticity of the structure, so that the body rests on a double arch; the points of the one are the heel and great toe, while the metatarsal bones form the other.

## CLVIII.

Having thus examined the bones of the tarsus, we next consider those of the metatarsus, which are five in number, and so named from being placed upon the tarsus. In respect to their general appearance, their bodies are long, arched upwards, and tapering towards their anterior extremities. Their extremities are large in proportion to their bodies, and the posterior ones much larger than the anterior, in order that they may be implanted with greater security in the tarsus; while the anterior ones connected with the toes, are so constructed by their small round heads, as to permit a greater freedom and ease of motion. The metatarsal bone of the little toe projects over the tarsus, and forms a jutting which can be easily felt externally.

## CLIX.

The last part of the foot is formed by the toes, which are five in number, and consist each of three distinct pieces or bones. These, from the manner in which they are dispersed, are termed phalanges, or ranks.

The great toe has two of these phalanges, and each of the others, three. The joints formed by the bones are round and free, in order to admit an ease of motion. The under surfaces of the bones are a little depressed or flattened, forming a



groove, where the tendons of the flexor muscles are lodged.

## CLX.

*Sesamoid Bones.*

To complete the osteology of the lower extremities, the sesamoid bones remain to be mentioned. From their small size, like pease, they are compared to the seeds of the sesamum, or oily grain. They are generally found in the seat of tendons, and at particular points of them, where they suffer much friction. Hence they are most conspicuous at the roots of the thumb and great toe; serving the same purpose as is assigned by anatomists to the patella. In their outer surface they are convex where applied to the ligament or tendon, and concave in their inner, or next the joint where they are lined also with cartilage. They are sometimes found at the roots of the other fingers and toes, at the condyles of the thigh, &c.; so that their appearance would seem casual, and the effect of accident rather, as regular design.

## CLXI.

*Superior.*

From the inferior, we ascend next to the superior extremities, which, like the former, are composed of three divisions, the shoulders, arms, and hands, which are all, indirectly as it were, appended to the trunk by means of a separate or

intermediate bone on each side, which merely glides upon it.

## CLXII.

*Shoulder Blade (Scapula).*

This bone is the scapula or shoulder blade, situated upon the upper and back part of the thorax, at a distance from the ribs, the interval being filled up with fleshy substance. It is a bone thin in its structure, and formed originally of two plates, with an intermediate diploe; which by pressure becomes gradually condensed and thinned in the progress of life. Its remarkable parts are,

1. Its smooth flat side, having a suitable bend to answer the convexity of the ribs, and laid upon the chest with its subjacent muscular substance that allows it to glide; by which means two motions are performed by it: the 1<sup>st</sup> being the motion of the shoulder bone upon the scapula, and the other the motion of the scapula itself upon the ribs. By this muscular substance also, the hollow of the scapula is marked by numerous inequalities.

2. Its irregular outer side, rendered so by the action of different muscles, divided by its ridge or spine crossing the bone, and forming a small upper and large under surface. All these parts are thickly covered with muscles, which take their name from their situation with respect to this ridge.

## CLXIII.

In describing the scapula, its figure is triangular, one of the angles being placed downwards. The upper line of the triangle is distinguished by receiving the muscles that raise the shoulder upwards, and is named the superior costa or border, being also the shortest. The lower border, or inferior costa, is free and unincumbered in its motions; and receives no muscles but the two small ones, or teres, which pull down the arm bone. The base of the bone, or posterior costa, is somewhat thick and swelled out, and into it are inserted a number of muscles which move the scapula in various directions, according to the various sets of their fibres. On the point of the scapular triangle, is placed the glenoid cavity, lined with cartilage, for the articulation of the os humeri; and towards this point the bone terminates in a flat surface, so shallow indeed as to receive only a small portion of the ball of the os humeri, though deepened a little by a circular cartilage that tips it. To the containing capsular ligament, therefore, the defence of the os humeri is chiefly entrusted; which rises from the bordering gristle of the cavity: hence its easy luxation from the small hold the os humeri possesses of the bony cavity.

## CXLIV.

The most remarkable part of the scapula is its spine, or that ridge, which traversing its upper surface, divides it into two, and gives attachment to the supra and infra spinatus muscles. It is small at its beginning, and becomes higher and broader in its course forwards, forming at its termination the high promontory, or tip of the shoulder. It is flattened at top, and from the slight inversion of its edges to either side, arise two tendinous membranes, which go the one to the upper, the other to the under border, dividing the bone into two cavities. The spine also receives part of the trapezius muscle, between its root and the base of the bone.

Next to the spine itself, is the acromion process, or end of it, named the top of the shoulder, which by forming a turn or distortion, and overhanging the joint, serves as a protection to the shoulder bone, and prevents luxation upwards. In the same manner is the joint farther defended by the coracoid process, which arises from the neck of the scapula, and stands directly forward with a crooked sharp point, compared to the beak of a crow. The joint of this process gives origin to muscles, and from its side, a strong ligament goes across to be fixed to the acromion, for the protection of the joint. Thus, by these three parts, the glenoid cavity, and the acromion and coracoid

processes, is the hollow for receiving the shoulder bone composed, and what this joint wants in actual strength, is supplied by the ease and freedom of its motions, which allow it to yield, and thus elude any resistance made against it.

## CLXV.

*Collar Bone, or Clavicle.*

The clavicle is situated between the upper part of the breast bone and the top of the scapula, where it acts as a support to the shoulders, and bears them off the trunk of the body. The chief parts of this bone are its two ends.

1. The *1<sup>st</sup>*, termed the thoracic or sternal extremity, is round and flat, so as to fit a corresponding hollow on the upper part of the sternum.

2. The *2<sup>d</sup>*, or scapular, is flat where it lies over the joint of the humerus, touching the acromion but in one point, and where they touch each other, they are tipped with cartilage, and are afterwards tied with strong ligaments by which the clavicle is enabled to form a fixed point of connection between the scapula and trunk.

## CLXVI.

*Arm Bone (Os Humeri).*

From the scapula and clavicle, we are led to the humerus or arm bone, which is placed at the side of the thorax and under the scapula. It is one of the most perfect cylindrical bones, round in the middle, flattened towards the lower end, and

regular and round again at the upper end. Its remarkable parts are at its upper part.

1. The head or ball, which is a large and regular part of a circle, having but a slight hold from the shallowness of the glenoid cavity that receives it, and it is therefore easily displaced.

2. The neck or line, into which the capsular ligament is implanted, which allows the bone an extensive motion in every direction.

3. The tubercles of this bone, which are two small bumps of unequal size, and distinguished from each other accordingly. They are situated behind the head of the bone, and receive the great muscles which move the arm.

4. The groove or space between the tubercles, which is deep for the reception of the long tendon of the biceps muscle, and is covered with cartilage to render it smooth.

## CLXVII.

Where the bone flattens at its under part, and changes somewhat of its former structure, the parts deserving notice are:

1. The two ridges that lead to the condyles for the attachment of strong tendinous fasciæ, which give origin to part of the muscles of the forearm, and allow them a broader extension.

2. The two condyles or projections themselves, which are two sharp points standing out from

either side of the joint for the attachment of muscles, and which give these muscles a longer fulcrum and more powerful action. The outer condyle is smallest, and gives origin to the extensor muscles; while the inner, larger than the former, gives attachment to the flexor muscles with which we grasp. It is also situated somewhat lower than the other, which rendering oblique the articulation of the elbow, makes the hands naturally fall upon the breast, with a tendency in them when brought together to cross.

3. The intermediate articulating surface, which, standing betwixt the condyles, limits the motions of the joint to those of a hinge.

4. The cavities within the joint or capsule, for receiving certain processes of the bones of the forearm. One on the forepart receives the coronoid process of the ulna, in the flexion of the forearm. The other at the back part of the bone receives the olecranon of the ulna in the extension of the forearm,—or that process which makes the joint of the elbow.

## CLXVIII.

### *Forearm.*

After the humerus, follow the bones of the forearm, which are two in number, the radius and ulna. The former so named from its resemblance to the ray or spoke of a wheel, the latter from its use as a measure.

*Radius.*

The situation of the radius is at the outer part of the forearm, and this bone belongs peculiarly to the wrist, turning with the hand in all its rotatory motions, and carrying the wrist with it so as to be termed the handle of the hand. The parts of this bone deserving a particular demonstration are,

1. Its upper end or head, covered with cartilage, and formed into a circle, hollowed above for receiving the outer part of the articular cavity of the os humeri, where it bends and extends upon that bone along with the ulna, and also for being articulated with the ulna itself, at its coronoid process.

2. Its neck, immediately behind the round head, surrounded in the subject by a circular ligament which keeps the bone in its place, and allows it to roll upon the ulna.

3. Its tubercle or prominent bump at the under and inner part of the neck, which is the point for the insertion of the biceps flexor muscle of the arm.

4. Its body, which is longer than that of the ulna, as on it the strength of the arm depends, which is convex also on its outer and back part, and rounded by the muscles which cover it. Between it and the ulna is placed the interosseous ligament.

5. Its lower head, which differs from the upper, in being broad and flat to receive the bones of



the wrist; and it is formed into a cavity of an oval form lined with cartilage, for admitting the two first bones of the carpus, named from its shape the scaphoid cavity; while at the edge of the bone next the thumb, it ends in a peak or sharp point, named the styloid process of the radius.

## CLXIX.

To conclude the description of this bone, it may be observed, that while the scaphoid cavity forms the joint of the wrist, there is also a semilunar cavity at the inner side of this under end of the radius lined with cartilage, that receives the corresponding extremity of the ulna, upon which the radius rolls, carrying the hand with it.

## CLXX.

*Ulna or Cubit.*

The ulna is placed at the inner part of the forearm, and is of a triangular form, becoming gradually smaller as it descends to the wrist. The most remarkable part of it is its connection with the humerus at the elbow. This connection is formed by a deep notch that closely embraces the humerus, termed the sigmoid cavity of the ulna; and this cavity is guarded before and behind by two processes, the olecranon and coronoid process. The 1<sup>st</sup> of these composes the large bump of the elbow, which is received into a deep hole of the humerus, and serves both to increase

the power of the extensor muscles, and to prevent a forward luxation of the part. The 2d or coronoid process rises perpendicularly on the forepart of the bone. Like the former, it increases the action of the muscles, and protects the part from luxation backwards. Thus the elbow joint consists of the sigmoid cavity, protected on each side by the olecranon and coronoid process, and on the outer side of this last there is also a smaller cavity, receiving the same appellation of sigmoid, and giving place to the round head of the radius on which it rolls. The next part of this bone are its ridges or sides. The chief of them turned to the radius, has an interosseous ligament passing between them attached to it, which strongly connects the two bones together, and gives a firm hold to muscles. The lower end of the bone forms a small round head, which is covered with cartilage on that side where the radius moves upon it, and also on its extremity, where it is opposed to a moveable cartilage placed between it and the carpus. The last part of the head is a small rounded point, which gives adhesion to a strong ligament that goes off to be fixed to the bones of the wrist, and this is termed its styloid process. Thus the olecranon and styloid process form the two extremities of the bone, easily felt externally, and hence employed at times as a measure.

## CLXXI.

*The Hand.*

The hand, the last division of the upper extremities, is the most complex in its form, and consists of three parts, the carpus, metacarpus, and fingers. Externally, this part is convex, and internally, concave, suited to its office of grasping and retaining substances.

## CLXXII.

*Wrist (Carpus).*

The carpus consists of eight distinct but irregular pieces, divided into two unequal rows; which, from their disposition, forms outwards an arch, with their broad ends turned in this direction. The individual pieces at one end of this arch are cornered and irregular, and their form is very little represented by their names.

## CLXXIII.

*First Row.*

r. The first of them is termed the os scaphoides or boat-like bone, which is the largest of the whole, and is received into the scaphoid cavity of the radius. Its chief points are its round cartilaginous surface, smooth, and fitted to the corresponding hollow of the radius, and its projecting process forming a corner point of the carpus, and giving attachment to a part of the ligament that fixes the tendons of the wrist.

2. The 2<sup>d</sup> of the carpal bones is the os lunare, so named from its shape, nearly of the same size with the former, and joined like it to the radius. Together they form a ball fitted to the socket of the radius, and of such a length as to render it in its motions a proper hinge. The chief parts of this bone are its lunated edge, turned towards the second row, and its round head forming the ball of the wrist joint.

3. The 3<sup>d</sup> of the carpal bones is the os cuneiforme or wedge-like bone, so named from its situation, by being locked in among the others. Its side, forming the convex of the hand, is broad. Its point towards the palm of the hand is narrow, and by being closely wedged between the cuneiform and pisiform bones, it is somewhat entitled to its name.

4. The 4<sup>th</sup> of the carpal bones is the pisiform or pea-shaped bone. It is placed upon the cuneiform bone, and forms that prominence which is readily felt in the wrist, and is one of the points of the arch under which the tendons pass. It is very moveable, and can be rolled about. It is also the point into which is inserted one of the strong ligaments for bending the wrist.

## CLXXIV.

*Second Row.*

1. The 1<sup>st</sup> bone of the 2<sup>d</sup> carpal row is the os trapezium, so named from the four unequal

edges of its posterior surface. Its chief parts are the great socket for the metacarpal bone of the thumb, placed a little to one side and next its process, which makes one of the corner points.

2. The next bone, termed trapezoides, much resembles the former, except in size, being smaller, and in its situation it is wedged in betwixt the two adjoining bones.

3. The os magnum is the largest of the carpal bones placed at the inner side of the former one, and in the centre of the upper row. Its round head or bill is received into the hollow surfaces of the os scaphoides and lunare in the manner of a ball socket, so that the second row by this means moves upon the first.

4. The last of the carpal bones, named the unciform or hook-like bone, is large and squared. In its situation it is wedged between the os magnum and cuneiforme. Its chief or remarkable part is its long flat hook-like process, projecting far into the palm of the hand, and forming the last and highest of the corner points. This process also gives a firm origin to the great ligament by which the tendons of the wrist are bound down.

#### CLXXV.

All the articulating surfaces of the carpal bones are covered with cartilage. They are secured to each other by many strong ligaments of every form, and thus united, they may be considered as

but one joint. Hence their firmness resists almost always luxation; and from their being placed in the manner of a wedge, broad externally, and with their smaller surface towards the palm, their arch supports whatever weight is applied to them; and it is only the displacement of one that can beat in the other.

The articulation between the first and second row of the carpal bones, allows motion to each side, but chiefly forwards and backwards; though the motion is less extensive than between the forearm and wrist.

## CLXXVI.

*Part annexed to the Wrist (Metacarpus).*

The metacarpus consists of four bones for supporting the fingers, and one on which the thumb is founded. In their structure they are big and strong, closely united at their carpal base, and swelling out as they proceed to be articulated with the fingers. Externally, the surface of these bones is convex, and internally, somewhat concave, as forming part of the palm of the hand. By the flatness of their lower heads, they are firmly implanted into the bones of the carpus, and possess the same degree of motion with them. By the size of their heads, they are kept asunder from each other; and room is given for the interosseous muscles. By their divergent form, their appendages, the fingers, come naturally to spread out.

The only motion required in them, is bending towards a centre, by which they increase the hollowness of the hand, of which they compose the far greater part.

## CLXXVII.

*Fingers.*

The fingers are composed each of three rows of bones or phalanges. These different phalanges taper a little as they descend, and their bases are longer than their middle and inferior extremities. The posterior surfaces of the fingers are convex, and chiefly covered by the tendinous expansions of the extensors of the fingers. Their anterior surfaces are flat, and in some parts concave, for lodging the tendons of the flexor muscles.

The 1<sup>st</sup> bone or phalanx of each finger, articulated with the metacarpal bones, forms a ball and socket; and has therefore an extensive or rolling motion. The second and third phalanges, articulated with each other, are more limited in their motions, and compose only a hinge.

## CLXXVIII.

*Differences of the Skeleton.*

Having examined the general structure of the skeleton, we are now prepared for considering the differences which takes place in individuals, as arising from the three circumstances; of period of life, of sex, and of species.

## CLXXIX.

*Skeleton of the Child.*

The difference that exists between the skeleton of the child and of the adult, consists in the imperfect ossification of parts; of course, in the greater number of the pieces, and in the extent of cartilage supplying the place of bone. Thus, when we descend into particulars, we find,

*Head.*

In the head, instead of sutures, as in the adult, the bones are joined by membranous expansions in the child, and the radiated appearance of the fibres in the broad bones are at this period conspicuous. In the cranium, the frontal bone consists of two pieces, and the superciliary holes and frontal sinuses at birth are not yet formed. In the parietal bones their sides are incomplete, and there is no parietal hole. The occipital bone is even divided into four pieces. In the temporal bones the squamous is separated from the petrous part, and the meatus externus is a cartilaginous ring. A cartilaginous partition divides also the ethmoid bone, which is afterwards formed into the nasal plate and crista galli. Of the sphenoid bone, the temporal wings are separated from the body, and there are no sphenoid sinuses. In the bones of the face, the differences are less observable than in those of the head, as the bones are in greater number, consequently of smaller size, and the ossification



therefore, even at first, is more advanced in them. In the superior maxillary bones, however, the sinus is only beginning to form; the os unguis shews a distinct separation and future. The under jaw is also composed of two pieces, joined together by the intervention of cartilage.

## CLXXX.

*In the Trunk.*

In the trunk the differences are less observable, from the great proportion of cartilaginous parts. The sternum, however, in the child is found composed of seven or eight pieces. The os sacrum is composed of five distinct pieces, which have intervertebral cartilages, the same as the true vertebræ. The os coccygis is also entirely cartilaginous, and the ossa innominata are distinctly separated into three divisions; of these divisions the spine of the ilium, and that part of the bone which belongs to the acetabulum, are cartilaginous. The spinous process, the tuberosity and crus of the os ischium, are also of a similar texture; and the crus of the os pubis, and that portion of it which forms the acetabulum, are also at this period in the same cartilaginous state.

## CLXXXI.

*In the Extremities.*

In the extremities the apophyses of the bones are all epiphyses in children. The long bones also shew distinctly their longitudinal fibres. The

patella is entirely cartilaginous at birth, and the bones of the carpus are in a similar state.

## CLXXXII.

*Skeleton of Old Age.*

Such are the chief distinctions between the skeleton of the child and of the adult. But while the number of pieces is increased by infancy, so they are proportionally diminished by the gradual progress of life, and in age this prevails to such a degree, that the cranium is often found to form but one solid piece or whole, without any marks of former division. The motions of the vertebræ become in the same manner lost; every part of the cartilaginous structure advances to ultimate solidity; and by this change of the softer texture, the functions fall to be impaired.

## CLXXXIII.

*Skeleton of the Female.*

The differences between the male and female skeleton, are at all periods of life conspicuous; and they are displayed both in the general scale of the body, as well as in the structure of particular parts.

## CLXXXIV.

Thus the bodies of women appear to be constructed on a scale proportionally smaller than those of men, and their bones seem to be less and more slender. The surfaces, and the various depressions and cavities conspicuous in the male, are less distinct in the

female, marking a less vigorous action of the soft parts upon them.

*Head.*

When we descend more minutely into particulars, we find in the head,

That the circumference of the skull is larger than in the male.

The os frontis is more frequently divided by the sagittal future.

The frontal sinuses are observed to be narrower, and all the bones of the face more slender and delicate.

CLXXXV.

*Trunk.*

In the trunk, the bodies of the vertebræ are longer, and also the intervertebral substance or cartilage is deeper and thicker; a circumstance which, perhaps, predisposes more than in the male to distortion in this part, on any exciting cause being applied.

The upper part of the thorax is also proportionally wider than in the male, and the under part is narrower; so that on the whole the chest in the female is less conical.

The true ribs also, are longer in their cartilages in proportion to their bony part, and broader and flatter to support the more extended surface of the female breasts.

The sternum is also more raised, though its

length is shorter than in the male, for it terminates in the female at the 4<sup>th</sup> instead of the 5<sup>th</sup> rib.

The thorax in the female is placed altogether at a greater distance from the pelvis, and the length of the loins is likewise greater than in the other sex.

## CLXXXVI.

But the distinctions are still more remarkable in the pelvis of the sexes, and they require a more special attention than elsewhere. These distinctions are particularly connected with the separate office of child bearing the female is destined to perform. Thus, while the male pelvis is large and strong, its openings small or confined, and its bones of great strength; the female one is wide, shallow, large in its cavity, and capacious in its openings. It is this part which particularly marks or characterizes the figure of the two sexes; for the proportions of the manly figure require the shoulders broad, the haunches narrow, and the thighs in a direct line with the body. While those of the female again are contracted shoulders, a broad haunch, the thighs large, round, and set at a greater distance, so that the knees approach. Hence the firmness of step in men, and the tottering unsteady gait of women.

## CLXXXVII.

But in tracing the different proportions of the pelvis, we observe that the brim in the female is more elliptic, approaching less to a circle than in the male; that the alæ of the ilia spread out more extensively. That the crura of the pubes are more expanded, and that the arch they form is less acute. That the angle of the vertebræ recedes also to a greater distance backwards; and that the sacrum is more deepened, possessing a greater convexity behind. That the inferior opening also is larger, appearing so at first sight. That the tuberosities of the ischia are placed more outwards; and that the lateral openings of the pelvis are all of a larger size. That the coccyx is both turned more backwards; and also possesses a greater degree of motion than in the other sex.

## CLXXXVIII.

In descending from the pelvis to the extremities, we remark that in the female, the ossa femorum are more curved; the neck of the thigh bone forms a greater angle with the body; and the internal condyle is larger. The feet are also smaller.

In the superior extremities, the bones are shorter; the scapulæ are smaller, and their angles more acute; the clavicles are less crooked; the ossa carpi are narrower; and the fingers more tapering towards their extremities.

## CLXXXIX.

*Skeleton of the Negro.*

Nor is the difference between the species, or between the white and negro, less remarkable than the difference between the sexes. Thus, in examining the skeleton of a negro, the cranium is distinguished in its figure by the narrow and retracting forehead and hindhead; by the flat bone of the nose, by the great distance betwixt the nose and mouth, by the small retracting chin, by the great distance betwixt the ear and the fore part of the mouth; by the small distance between the foramen magnum and back part of the head, by the large bony sockets which contain the eyes, by the wide meatus auditorius, and by the long and strong under jaw.

The other distinctions lie chiefly in the extremities, and consist of the long forearm, of the bones of the thigh and leg more gibbous, of the flat foot, and of the particular length, breadth, shape, and position of the os calcis.

## CXC.

*Chemical Analysis of Bones.*

Thus the bones we have seen form the foundation of the body, and are the basis on which all the other parts rest. Before concluding the demonstration of them, it is proper farther to examine the principles of which they are composed, as unfolded by chemical investigation.

## CXXCI.

From this investigation it appears that the bones are not simple earthy matters; but consist of four different principles.

1. An animal jelly, which is displayed by cutting them in pieces, rasping them, and boiling them in water; which becomes viscid, and loaded with gelatinous matter.

2. A medullary oil or marrow, which we have seen contained in a particular membrane, serving for the nourishment of the bones.

3. An animal earth, which consists of calcareous earth and phosphoric acid; the latter of which is separated by pouring on calcined bones, sulphuric acid.

In the foetus, this animal earth forms a third part of the bones; in the adult it forms about a half; but in old age it greatly exceeds this proportion.

4. A fibrous gluten or mould, in which the animal earth is deposited, which appears by macerating bones for a long time in vinegar or diluted nitrous acid; when they dismish their earth, and become soft and bend.

## CXXCII.

*Recent Bones.*

In their recent state, the bones are chiefly distinguished from their appearance in the skeleton by their colour, which is various; some being white, some red, and some bluish. The more compact the

substance of the bone, the whiter is its colour; and the more spongy its structure, the more is its colour varied.

## CXCIII.

This variety of appearance depends principally on the size and number of the blood vessels dispersed through them.

## CXCIV.

Hence this cause occasions a considerable difference in the colour of the bones at different periods of life. Thus the bones of adults are white, but those of children are reddish. In the prime of life also, the bones are manifestly redder than in old age; when the number of vessels gradually decreases.

Particular mode of life has likewise a considerable influence on the colour of the bones. Thus hard labour occasions the bones of the same age to have a greater whiteness than indolence and inactivity; and the use of mercury particularly prevents a white appearance of the bones.

## CXCV.

Along with the consideration of this difference of the bones in their recent state; the appendages also which belong to them, the periosteum and marrow, require a special notice.

## CXCVI.

*Periosteum.*

The periosteum we formerly mentioned is that thin membrane which every where covers the ex-



ternal surface of the bones. It is of a compact cellular texture, closely connected to the bones by the intervention of blood vessels and small filamentous threads; and if denuded of the bones, its expansions would retain the general appearance of the skeleton, so extensively is it spread. It consists of several layers condensed together, and though not itself vascular, it is through it that vessels are transmitted to the bone. Hence, while the bone is reddened by an injection, the periosteum is little affected. It forms the medium of nourishment to the external layers of the bone, in the same manner as the marrow does to the internal ones. Hence an injury of the periosteum produces exfoliation of the bone, or in other words, the death of the external layers; its vessels also gradually decrease in the progress of life, as the bones require less nourishment; or rather, they are turned into connecting filamentous threads, instead of vessels. Besides forming in a certain degree the medium of nourishment to the bones, this membrane allows the parts above, particularly the muscles, to slide easily upon them. By it the different pieces of bone become connected, and a general uniting medium between the bones, or the hard and soft parts, is composed by it.

## CXCVII.

*Marrow (Medulla).*

The marrow is contained in a fine membrane.

investing the inner cavity and cells of bones. It is a secretion from a number of minute arteries spread upon its surface, and passing into its cells to deposit their contents. In these cells, or bags, which it forms, is the marrow locked; the use of which is to convey the same nourishment to the internal parts of the bone, which the periosteum does to the external. Hence any injury of the marrow produces a complete death of the bone, while that of the periosteum produces only a partial effect, or exfoliation of the outer part. This membrane or vesicular structure for the marrow, which prevents its being effused when exposed to the heat of boiling water, is supported in its place by the bony filaments of the reticular substance, or cancelli of the bones. The transmission of the marrow to the bones is of the first importance. It is insinuated between the plates of the hardest of them, and even in the skeleton the transfusion of it through them is conspicuous. The sensibility of the medullary covering is considered as small by most authors, but it acquires a high degree of it under disease. Very little tinge can be given to this substance by injections of madder, and the presence of lymphatics in it has therefore been doubted. Its connection indeed seems stronger to the secretion of marrow than to the bones, for it can even be drawn out entire from the cavity of a bone.

## CXCVIII.

Different periods of life change this secretion or marrow in its appearance, and this change is connected with the decrease of the circulation to the membrane. Thus, in infancy, by its numerous vessels it is red; in manhood, yellowish; and a deep yellow in old age. In the same way, in the latter period, the bones acquire a brittleness, and are easily fractured from a defect of its supply.

## CXCIX.

*Chemical Analysis of Marrow.*

In subjecting the marrow to chemical experiment, it appears an oil mixt with jelly. Its consistence is thinner than the fat of every other part of the body. In embryos it is almost gelatinous, and after death, opaque. It yields the same products as other oils, with the addition of a substance of the consistence of butter.

## CC.

To finish the demonstration of the skeleton, the only bones that remain are the teeth, which are bones of a peculiar structure, and formed for the particular purposes of mastication, and the articulation of the voice.

*Teeth (Dentes).*

Teeth are the hardest and whitest of the bones. They are originally wanting, or rather do not appear till a necessity arise for their use, and from this cause they are unfolded at different periods,

which occasions dentition to be divided into different stages. In the adult, or at full maturity, there are thirty-two in both jaws; and this number they never exceed, though they sometimes fall short, and have been found only twenty-eight.

## CCI.

In its general structure, each tooth is divisible into three parts; its body, its neck, and its fang. The body is that part which appears above the gums, its fang or root is that part buried in the socket or jaw, and its neck is the intermediate line between the two, close to the edge of the gum, and marked by a slight circular depression.

## CCII.

In its substance, each tooth consists of its enamel or outer covering, and its osseous part, or internal structure. The former of these is a substance peculiar to teeth, hard, white, and compact, and only allotted to that part of them situated without the socket. In its formation it consists of a fibrous or striated texture, having its fibres directed from the circumference towards its centre. The thickness of the enamel is generally not more than the one-eighth of an inch, though it varies a little at different parts, being gradually thinner towards the neck, and thickest and strongest at the surfaces or active extremities.

The osseous part of the teeth is the same as other bone, only in the teeth it would appear to receive

a closer condensation than elsewhere. It comprises the whole of the tooth except the outer covering of the body by the enamel.

## CCIII.

Though from their very condensed structure it is impossible to demonstrate the vascularity of teeth in a great degree, yet the circumstances which attend their diseased state clearly shew their possession of circulation, sensibility, and absorption, the same as prevails in the soft parts.

## CCIV.

Each tooth displays an internal cavity, opening at the point of the fang, and gradually enlarging as it extends to its body. This cavity receives a supply of blood vessels and nerves, which are thus distributed through the teeth; and the obliteration of this cavity in age, renders the tooth callous and insensible.

## CCV.

The teeth possess two appendages, the periosteum and gums; the former common to them with other bones, and extending from the fang to the neck, where it closes in, or becomes attached to the gum. The latter a peculiar red substance, or investing cushion, covering the alveolar processes, leaves a perforation for each tooth through its highly vascular and hard elastic texture. The degree of its hardness is very great in infancy,

and it has even a ridge extending through its whole length, which is lost in age.

## CCVI.

The teeth, from their shape and offices, are divided into three different classes, the incisores, canini, and molares.

The incisors are the four teeth in the fore-part of each jaw. In examining them, they have each two surfaces that meet in a sharp edge. Their anterior surface is convex, and their posterior one somewhat concave, and being usually broader and thicker, especially the two first in the upper jaw ; it falls over those of the under jaw.

The canini derive their name from their resemblance to the tusks of a dog, and they are at the same time the longest of all the teeth. Their fangs are larger than those of the incisors and they are placed one on each side the incisors in each jaw. Their base appears in form of a wedge pointed in the middle.

The molares, or grinding teeth, are ten in each jaw. They differ from the former in their use, as well as in their structure. Instead of a single fang or root, they have two in the under, and three in the upper jaw ; and they likewise differ from themselves, as well as from the other classes. Thus the two first possess a form between the incisors and molares. They possess, like the incisors, but one root ; but they terminate like the

caninus, in two points, of which the anterior one is highest. The two next grinders are much longer, and their surface possesses five protuberances, two on the inner, and three on the outer side. The last molaris is shorter and smaller than the rest, and so late in its appearance, as to receive the name of the *Dens Sapientiæ*.

### CCVII.

The formation of the teeth takes place at a very early period. About the fourth month, the alveolar process is found only a shallow longitudinal groove, divided by slight ridges into a number of intermediate depressions, which compose at last the future alveoli or sockets. But in the fœtus there is found only the outer shell of five deciduous teeth, and of one permanent tooth on each side the jaw. Between the inner side of the deciduous teeth and the alveoli in the fœtus, little capsules are placed, and connected by processes with the gums, in which the incisors and canini are afterwards formed; but at this time there is no appearance of the rudiments of any of the teeth. The first appearance of the teeth, is the filling of the alveolar depressions with small pulpy substances, included in a vascular membrane. In forming the teeth, the surface of this pulp first begins to harden, the ossification proceeding from one or more points, according to the kind of tooth that is to be formed. Thus the incisors

and canini display but one ossifying point, the molares four or five.

## CCVIII.

By the progress of this ossification, the pulp is gradually converted into bone; and on its under surface, last of all, the fang comes to be formed. The bony part receives then a crust of enamel, which is secreted in a manner not yet explained, and is equally compact before as after birth. During the progress of the enamel, the lengthening of the fang or root takes place; and according to the number of fangs, the points of ossification to form them are conspicuous. By the growth of the fang, the tooth is pushed upwards; and accordingly makes its appearance beyond the gum, about the *5th*, *6th*, or *8th* month; although we find on the one hand, instances of children who have been born with them; and on the other, where they have not appeared till a late period. In the former case, their number is confined to the incisors. They have even at times been discovered in fœtus of seven or eight months, but in all such premature examples, they have undergone a rapid decay in the course of a few weeks or months from their first appearance. In the latter case they have been known so late as from thirteen to nineteen months, before their first marks of protrusion.



## CCIX.

The common order of protrusion, is a subject that should be much attended to. In each tooth, two stages of its progress may be remarked: the one, is the stage of its increase or growth; the second, of its progress to appearance, or actual denudation. The symptoms of the first are often both nice-to discriminate, and also most fatal at times to the constitution of the child. Those of the second are generally denoted by certain external marks.

## CCX.

From examining the form of the teeth, it will occur that the difficulty of protrusion must depend on their departure more or less from an acute or pointed figure; and, also, according as the state of the parts obstructs their progress. Hence, as the incisors possess both an acute form, and as the jaw is there thinnest, their protrusion falls to be first. The two small incisors of the lower jaw, cut the gum about the seventh month, or earlier. They follow each other in about fifteen days. The large ones of the upper jaw appear nearly at the same time, after which the side ones of the lower jaw appear in course, and are followed by the same in the upper jaw, and thus the incisors are complete. At eleven months, the canini of the lower jaw, which form the second order in point of acuteness of form, divide the gum; and, in

the course of some days after, are accompanied by those of the upper jaw. At a year old or upwards, two small molars advance in the lower jaw; and in a few days are joined by those in the upper. The remaining four are generally not seen till two years of age or upwards; and when appearing, they complete the milk teeth, or first set. But the interval between the different teeth is by no means so exact as here stated; and often a very considerable lapse of time, intervenes between them.

## CCXI.

The first set, or milk teeth, twenty in number, are remarked by authors, as distinguished by their superior whiteness and regularity. It has even been supposed by some anatomists, that they had no root; but this opinion is combated with his usual force by Albinus. At the same time, there is no doubt that the root is destroyed in part by the time they fall, or are succeeded by a second set; and that even the septum of the sockets is obliterated. This naturally happens as a consequence of pressure by the second set, in their progress to protrusion.

The first set is completed by the age of three years; and in strong robust children by  $2\frac{1}{2}$ , but seldom sooner. Their protrusion, or the first dentition, forms the most critical period in in-

fancy; and from it the future state of delicacy in childhood is often to be traced.

### CCXII.

The second set, or adult teeth, replace the milk teeth from the age of seven to fourteen, during which the former set are gradually shed. These permanent teeth are all found in a distinct set of alveoli, and by the increase of the latter, so as gradually to obliterate the former alveoli, their teeth drop out, and they totally disappear. But besides this, the second sockets are larger, and acquire also additional teeth, or three grinders on each side, by the lengthening of the jaw for this purpose. Hence the face, from the shortness of the jaw, is flatter and rounder in children than in adults.

### CCXIII.

These last molares cut the gum at different periods. The first generally passes at twelve years of age, the second at seventeen or eighteen years, and the third, or Wisdom Tooth, not till twenty or thirty, sometimes not till thirty-five.

Though two sets of teeth are the common portion of most individuals, yet, in some rare instances, a third set has made its appearance after the age of sixty. This appearance has commonly been attended with other peculiar circumstances, marking somewhat of an effort of nature towards a complete renovation of the system.

## CCXIV.

The form of the human teeth, thus examined, appears different from those of all other animals. Thus the canini are not longer than the rest, nor yet curved as in the beasts of prey. The incisors are not so sharp as in animals, and the molares are flatter and more blunt in their edges. From these peculiarities therefore, man is designed for a different or mixt aliment, and is fitted equally to live on animal or vegetable diet.

## CCXV.

*Chemical Analysis of Teeth.*

Teeth consist of two parts, bone and enamel. The analysis of bone was formerly examined as consisting of jelly, medullary oil, earth with phosphoric acid, and gluten. The enamel again differs from this, in being entirely phosphate of lime, cemented by gluten.

## CCXVI.

*Anatomical Preparation of Bones.*

In studying anatomy, it is necessary to prepare the bones for use; and this is done either naturally or artificially.

*Natural Skeleton.*

1. The natural skeleton is confined to young subjects. It is formed by removing every part from the bones, except the connecting ligaments and cartilages, which are to be carefully avoided. When the parts are removed, the body is then to be macerated in clean

water, which is to be changed every day; and this process is to be continued till putrefaction advance so far, that a separation of all the remains of the soft parts can be made by dissection. When this is finished, the body is to be again laid in water for a day or two; and afterwards, for a few days into lime water, or a solution of potash. It is then washed clean, and hung up to dry. In this preparation, the arms are removed from the trunk, and again artificially joined. The brain is also scooped out through the bregma, or the trephine is applied for the same purpose.

*Artificial Skeleton.*

2. The artificial skeleton is generally preferred to the former, as the subjects of it are adults, or bodies at full growth. It is made by dissecting the flesh as much as possible from the bones; then separating the bones to such an extent, that they can be laid in a vessel. When laid there, they are to be covered with water, which is to be every day changed for about a week. After this, it is to remain unchanged, occasionally filling it up, so as to keep the bones covered till putrefaction remove all the remains of the soft and ligamentous parts, which requires a period from three to six months, according to the circumstances of the state, and temperature of the season. To facilitate the cleaning of the long cylindrical bones, holes may be bored in them to allow the access of the water to their cavities, and the corruption of the medullary matter.

3. When putrefaction has so far taken place as to destroy the ligamentous parts, the bones are in a state to be cleaned or to be scraped from all superfluous

adhering matter. When this is done, they should be then steeped for a few days; afterwards immersed in a solution of potash, or in lime water for a week; and then washed clean, and submitted to dry. This is to be done best, by exposing them to a gradual heat.

4. In preparing the bones of the artificial skeleton, the head requires particular attention. It is submitted to maceration like the other bones, after first making numerous incisions through the scalp, to facilitate the separation of the soft parts; and when putrefaction has sufficiently advanced, they will easily separate. The bones are then to be scraped, and the brain evacuated through the foramen magnum, by first breaking it down, and introducing for this purpose something through the aperture. To separate the bones of the cranium, the head must then be filled with dried peas well shaken in, so that it may be completely crammed. In this state, it is to be put in water, so that the pease may swell, and occasion a uniform pressure on its internal surface, by which a separation of the principal bones at the sutures will take place; and this separation may be afterwards easily extended. The head of a young subject should always be preferred for this purpose.

5. The bones thus prepared and dried in order to form the skeleton, must be properly and conveniently arranged, and then joined by means of slender flexible wire.

The lower jaw is to be fixed in its situation by passing wire through its condyloid processes and each temporal bone, in order to bring the articulating surfaces into contact; and this fixing should be so made, as to pre-

serve the motion of the jaw. The anterior portion is to be prevented from falling down by a spiral wire fixt to the os sphenoides; and its end to the middle of another wire, extended from one angle of the jaw to the other, in the form of a bell spring.

The atlas, or first vertebra, is then to be fixt by means of wires pass'd through it and the base of the occipital bone, in such a manner as may best confine its natural situation, no motion being necessary between it and the parts to which it falls to be connected. Across its opening, a strong wire is next to be placed, forming on its anterior part a circle fit to admit the end of the finger; and through this circle the upper end of a large wire is to pass, upon which the vertebræ are strung.

6. This wire in size should not exceed a large goose quill, and on it all the vertebræ are to be strung in their proper order, and in its incurvation the natural bend of the spine is to be imitated, and holes pass'd through the body of each vertebra to admit it. Its lower end should enter the sacrum, on the inner side of which, an inch from the top, a hole being driven, the wire is to be there secured by a pin. The cartilages of the vertebræ are to be imitated by thin circular pieces of cork,  $\frac{3}{8}$  inch thick anteriorly, and sloped off in the form of a wedge, which are to be interpos'd for ten or twelve joints above the sacrum. Their thickness also should be gradually lessened as they advanced upwards, till it come to  $\frac{1}{2}$  inch; and, when the spine is complete, these pieces should receive a covering of flour and water, mixt with a small proportion of burnt umber. The end of the wire connecting the vertebræ, is to be pass'd through the

circular wire of the atlas, and then through the foramen magnum above the superior part of the cranium, where it is to be confined by a nut, screwed upon the top of the wire, close to the bone.

7. The ribs are next to be united to the transverse processes of the dorsal vertebræ by slender wires through their posterior extremities; and, in doing this, the lower ribs must be first articulated on each side, advancing upwards.

When their posterior extremities are thus connected, their anterior ones are to be supported by narrow slips of leather, formed in imitation of their cartilaginous appendages, which connect them with the sternum. In forming these slips, the structure of the parts must be attended to. These slips are to be fixed to the ribs by making in the ribs a perpendicular slit about  $\frac{1}{2}$  inch deep, with a saw to admit them; and to this slit the extremity of the leather is to be adapted, and then secured by glue or a pin. The same joining may be made to the sternum, by introducing the ends of the leather into the natural situation of the cartilages. When finished, the application of paste over the joinings, will render the appearance natural.

The clavicles are next to be placed in their natural situation, and secured to the sternum by slender wire passed through them; and to the scapula they may be articulated in the same manner.

The scapulæ are to be connected with the trunk by means of wires passed through their inferior angles, and the ribs situated immediately in this situation.

8. In the bones of the pelvis, the ossa ilii are to be



joined to the lateral edges of the sacrum, by passing two strong wires through the outside of the posterior part of the ilium from side to side, and piercing the thick part of the sacrum at the distance of  $1\frac{1}{2}$  inch from each other; which wires are to be secured at its extremity, by placing a nut with a screw upon them.

The same connection may be made between the sides of the ossa pubis, by passing one or more wires from side to side, and securing them by rivets. The cartilage of the symphysis is to be supplied by a small piece of cork plaistered over; and the os coccygis is to be articulated with the point of the sacrum by a tin plate and two pins.

9. The extremities are more difficult to connect than the head and trunk.

In the superior extremities, the connection is made by making a longitudinal oblique incision with a saw, an inch deep, through the head of the humerus; and fixing in this part a screw 2 inches long, the upper half of which being flattened, and having a hole for a cork near its top, secures the bone in its situation by passing the wire laterally through its head; and at the same time admits in the bone a freedom of motion. The projecting part of the screw again is to be fixed in the glenoid cavity of the scapula, and secured by a nut.

The elbow, the next part, is articulated by a tin plate and pins. A circular piece of plate, an inch in diameter, is fixed edgeways in a longitudinal direction into the ridge of the notch formed by the curvature of the olecranon, and kept in its place by passing two pins from side to side. The projecting part of the

tin is next to be received into a slit made with a saw in the lower end of the humerus ; where being confined by a pin passed through it and the bone, by this mode of connexion a freedom of motion will be permitted.

The upper extremity of the radius is joined to the anterior process of the ulna by a small oblong piece of tin plate, one end of which being fixed transversely in the outer surface of the process, the projecting end is received into a transverse incision of the lateral surface of the radius at its articulation. This incision is made with a saw about  $\frac{1}{4}$  of an inch from its superior extremity ; and the plate is confined in its situation by a pin passing longitudinally through it, and secured to the bone. The lower extremity of the ulna is articulated to the radius in a manner exactly similar to the upper one, and therefore does not require repetition.

The two radial bones of the wrist are joined to it by two oblong pieces of tin plate, and secured by pins in the manner already described, so as to admit of flexion and extension.

The carpal and metacarpal bones are to be confined in their situation by wires passed through them in a convenient direction.

The thumbs and fingers are joined by small oblong tin plates, properly adapted for the purpose. Each plate is to be fixed in the upper extremity of the bone, by slitting each bone longitudinally with a saw to a proper distance to receive it ; and the plate is then secured by passing a pin laterally through the bone, and in this way sufficient motion will be permitted.

In the lower extremities, a junction with the pelvis

is made by flitting the head of the femur as far as its neck with a saw longitudinally. Into this part a screw, two inches and a half long, and flattened for one half its length, is to be fixed; and this screw is to be secured by a transverse pin, passed laterally through the head of the bone, and through a hole made near the flat part of the screw. The projecting end is then to pass through a perforation in the middle of the acetabulum, and is to be confined by a nut passed over it within the pelvis; while, at the same time, it is done so as to allow a freedom of motion.

To the tibia, again, the femur is connected by a slip of tin plate, about 4 inches long, and  $\frac{3}{4}$  broad; which is to be doubled across its middle, so as to bring the two ends even. The inner surfaces of the tin are to be closely applied to each other, except at the bend; where an open loop is to be formed for the passage of a wire about the size of a crow quill. The two extremities of this tin plate are to be inserted perpendicularly into the posterior edge of the articulating surface of the tibia, so as to project from the bone about an inch; that the loop may be situated transversely between the two condyles of the femur, when the bones are naturally placed. They are then to be connected by passing a wire transversely and laterally through the condyles near their posterior surfaces, and through the loop of the tin plate. That part of the plate inserted into the tibia, is to be secured by two pins driven into its posterior surface, so as to pierce the plate in two different places.

The patella is joined to the anterior edge of the su-

perior extremity of the tibia by a tin plate 2 inches long, and  $\frac{1}{4}$  inch broad; passing upward into the inferior edge of the patella, and downwards into the anterior edge of the superior extremity of the tibia; where it is secured by a pin driven into the bones in such a direction, as to pierce the tin plate.

10. The fibula is connected to the tibia at its two extremities by two oblong tin plates, fixed into four flits made perpendicularly with a saw through the centre of each articulating surface, and secured by pins passed transversely through the bones and plates, in the manner already described.

11. The tibia, at its lower extremity, is to be joined to the astragalus, by introducing a tin plate into a slit made in each perpendicularly with a saw, and securing the plate by pins passed transversely, one through the tibia, and another through the astragalus; and, by a hole in each end of the plate, the natural flexion and extension of the part will be allowed.

The os calcis is to be secured in its situation by connecting it by wire to the astragalus, and that in the most convenient manner. In like manner is the scaphoides to be united to the anterior part of the astragalus, and the other bones of the tarsus may be joined in a similar way.

12. The metatarsal bones may be connected to the corresponding tarsal ones by wires or tin plates, as employed for the fingers. A wire should be passed transversely through the anterior extremities of these bones to unite them to each other, and keep them in their places.

The bones of the toes are to be joined to the metatarsal bones by tin plates in the same manner as described in the fingers; or else a wire may be passed through the under part of the thick anterior extremity of the metatarsal bones longitudinally, and through the centre of the bones of the toes, securing the wire at the end by a small clinch.

13. By this manner of forming the bones into a skeleton, or placing them in their natural state, the study of osteology is facilitated; but, in order to understand farther the intimate structure of bones, or to demonstrate their particular parts, different modes of preparing them are had recourse to; and by these preparations may be shewn,

1. The fibrous texture of bones, and the pliancy and flexibility to which they can be reduced.

2. The vascularity of bones, and

3. Their internal cancellated appearance.

14. To shew the fibrous texture of bones, let a bone be immersed in a weak acid liquor made of an ounce of muriatic acid, and one quart of water in a glass vessel, in which solution it must lie from three to four months. By the end of this solution, the earth of the bone will be neutralized, and in time separated from the fibrous part. To be successful, much time must be given for completing the process; and the acid occasionally added to the liquor, which should never be too strong. In this state, the bones become perfectly flexible.

15. The vascularity of bones is shewn by the same process; but, in order to do it, not a single bone, but the whole extremity must be taken; and, when

thoroughly heated by immersing it in hot water, it is to be injected by the arteries; and on finishing this part, the bone may be submitted to the former process.

16. To demonstrate the cancelli of bones, the middle part of the os femoris should be cut into portions of two inches in length, by means of a fine saw, steadily used. These pieces should be submitted to maceration in water for two or three months, to remove all their medullary oil; and, when dried, the reticulated structure of the cancelli will appear distributed through the cavity. Recent bones answer here best.

*Preparation of the Periosteum.*

The structure of the periosteum is shewn by taking part of it from an injected subject, which must be laid in water, and the water should be changed every day while any bloody tinge appears. When removed from the water, it may be either preserved in its wet state in a vessel with spirits of wine, or it may be dried, and placed in oil of turpentine, or preserved by varnish.

## PART II.

### DEMONSTRATION AND DISSECTION.

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#### CCXVII.

HAVING now demonstrated at sufficient length the structure of the bones, or the basis of the body; we proceed next to what we have termed Demonstration and Dissection, or to view the machine in its natural state, beginning our investigation with the surface, and extending our view internally, as the parts become unfolded by the knife.

#### CCXVIII.

##### *Common Teguments.*

The first part that arrests our attention on this plan, is the common teguments, which consist of three parts, the cuticle or epidermis, the rete mucosum, and true skin.

#### CCXIX.

##### *Cuticle (Epidermis).*

The epidermis, or scarf skin, is a thin, almost transparent, and insensible membrane. It is easily

separated from the parts below by maceration, putrefaction, or the application of a blister. It varies in its thickness in different places, both originally as we find in the fœtus, and also farther in consequence of pressure in the course of life. When minutely examined, it is composed of layers or laminæ, which are more distinctly separable from its greater thickness in the negro than in the white subject. Its external surface is also marked by furrows corresponding to those of the true skin, by which its shape is adjusted; and it is distinguished by numerous perforations. *1<sup>st</sup>*, From the exhalant vessels which throw out the perspiration or sweat. *2<sup>dly</sup>*, From the extremities of excretory ducts, which appear only in particular parts of it. *3<sup>dly</sup>*, From the openings of absorbents, which take up whatever is applied to the surface: and *4<sup>thly</sup>*, From the holes for transmissiion of hairs, which are very numerous over it.

The first, however, or what are termed the pores of the skin, are most conspicuous upon the palms and soles, and also upon the nose, ears, and penis.

## CCXX.

The cuticle, or external covering, pervades every part of the surface except under the nails. It is reflected also inwards, to line the principal passages, particularly the alimentary canal, trachea, &c.; and in these situations it becomes somewhat



changed in its texture. Certain processes also, where it forms the lining of passages, connect it with the skin.

## CCXXI.

On the formation of this part, various opinions have been formed by authors, the most probable of which is, that it is produced by a condensation of the next part, or corpus mucosum, or else by the extremities of excretory vessels. Such is its density, that no vessels can be traced in it.

## CCXXII.

The functions of the cuticle are various. It protects the sensible parts below from external irritation. It regulates the proportion of fluids received into and expended by the surface, and thus it hinders that degree of evaporation that would prove hurtful.

## CCXXIII.

*Rete Mucosum.*

The second part of the teguments, on removing the cuticle that comes into view, is what is termed the rete mucosum, so named from its supposed resemblance to a net work. This part is composed of the extremities of small vessels passing between the cuticle and true skin, but involved in or surrounded by a viscid substance. This substance is extremely thin, and separated with difficulty in the European, but it is thicker and softer, consequently easily,

investigated in the negro, in whom it can even be divided into two distinct layers. Its texture however is so soft, that it suffers a complete solution by maceration in water.

## CCXXIV.

It is to this part, the variety of colour conspicuous in the natives of different climates, and also in individuals of the same climate, is chiefly to be referred. Thus it is of a white, or rather light grey semi-transparent colour in the European, black in the Ethiopian, and brown in the Asiatic, and its shades vary more or less in almost every individual.

## CCXXV.

Like the cuticle, this part pervades the whole extent of the surface except the nails, and it is also marked by the ridges of the cutis vera. Its colour is somewhat lighter in the palms and soles than elsewhere.

## CCXXVI.

The functions of this part are not wholly determined. It clearly serves as a cushion or defence to the small cuticular vessels, and in the warmer climates probably hinders also the too great penetration of the solar heat.

## CCXXVII.

*True Skin (Cutis Vera).*

The true skin, the last and principal division of the teguments, gives a general covering to the

whole body. It is formed of fibres closely compacted together, and so interwoven, as to run in every direction. It is plentifully supplied with blood-vessels and nerves, so that the smallest puncture gives pain and draws blood. Such is the number and size of its vessels, that the skin can be readily injected. In its texture it is strong, elastic, and capable of considerable elongation; and from these qualities in quadrupeds, it is converted into leather. Its strength and density, however, is greater externally than internally; and it is also thicker and looser on the posterior than on the anterior parts of the body, and thickest and strongest on the palms and soles, than on any of the extreme parts.

## CCXXVIII.

From the different proportions of its circulation, the colour of this part differs in different parts of the body, and the thinness of the cuticle produces also the same effect as at the edge of the eye-lids, the red or vermilion part of the lips, &c.

## CCXXIX.

In examining the structure of this part on removing the former divisions, it seems every where beset with innumerable papillæ or eminences, which appear like minute granulations. In these papillæ is supposed to reside the organ of touch, from their extreme sensibility and vascularity.

Their appearance differs somewhat in different parts of the skin, as on the inside of the lips, where they are termed villi. They are most conspicuous on the palms and soles, where they appear placed in double rows upon the ridges running on the points of the toes and fingers in a somewhat spiral and parallel direction, and by these ridges they are both defended, and the perspirable surface increased. Besides this general structure, various folds are observed in the skin, which depend on the particular form and texture of the more internal parts; and where these folds exist, the skin is thinner than elsewhere, to allow a pliancy and ease of motion.

## CCXXX.

From this account of its structure, the uses of the skin are to give form to the body, to unite the different parts of it, and to defend them from injury. Besides which, it forms the external organ of sensation, and gives passage to the various fluids absorbed or perspired; but in order that it may execute these functions properly, it is preserved moist by the rete mucosum, and it is guarded from external injury by the cuticle, and also has the excess of its sensibility taken off or diminished.

## CCXXXI.

After this general view of the form of the skin, we are next led to examine what have

been termed its appendages, the first of which is the nails.

## CCXXXII.

*Nails.*

The nails are proved a continuation of the cuticle by their separating along with it by boiling water or maceration, by their similar insensibility and apparent want of vessels, and by their being renewed when removed. They are composed of different layers applied over each other, formed of longitudinal fibres, but of unequal size. In their dead state, when detached from the body, they are entirely transparent; but they receive circulation and colour in their natural situation from the vessels of the skin to which they adhere. Their origin is by a square root a little before the last joint of the fingers and toes, and they are fixed at their roots by a semi-lunar fold of the cutis, over which is reflected at this part, the covering of the cuticle adhering to them. Their growth takes place from their roots, not from their points.

## CCXXXIII.

The use of the nails is to defend from injury the extremities of the fingers and toes, to increase their powers of apprehension, and especially to render minute objects more easily taken hold of.

## CCXXXIV.

*Hairs.*

Next to the nails, as an appendage to the skin,

fall to be examined the hairs. The appearance and colour of the hairs, differ both in different parts of the same body, and they differ also in different individuals. They arise by roots or bulbs, which have their seat in the cellular substance under the skin. These bulbs are of various shape in different parts of the body, and are furnished with blood-vessels dispersed upon them for their nourishment.

## CCXXXV.

Each bulb is divisible into two membranes or capsules, within which is an oily fluid, supposed to give colour to the hair; by want of which from age, or under disease, it becomes white. The body of the hair, or outer part, consists of smaller hairs inclosed in a membrane; and they vary in softness and colour, according to climate, age, and constitution. The growth of the hair, like that of the nails, is from the root.

## CCXXXVI.

Though ornament and warmth may be considered as one use of the hair; yet it is certainly intended by nature for other important purposes with which we are still unacquainted.

## \*CCXXXVII.

*Sebaceous Follicles.*

In parts of the surface exposed to air or friction, the skin possesses a particular appendage, or secretory organs, termed the sebaceous ducts or fol-

licles. These contain an unctuous matter, which can be squeezed out, being often of a firm consistence, and resembling a small worm. The seat of these ducts is under the skin, and they are most conspicuous in the nose, ears, nipples, groins, and external parts of generation.

Their use is evidently by means of their fluid, to lubricate and defend from irritation.

### CCXXXVIII.

#### *Miliary Glands.*

In the same manner in the arm-pits, we find what are termed miliary glands, from their resemblance to millet seeds. This structure has been considered as general over the skin, though it does not bear demonstration from its minuteness.

### CCXXXIX.

#### *Cellular Membrane (Membrana Cellularis).*

But a more important part, and which forms a still more general covering than the skin itself, is the next division of the animal structure that appears on dissection, or what is termed the cellular membrane. It invests every part of the body, the most minute we are able to trace. It is composed of a fine web, formed of many membranes connected together in an irregular manner, and made up of cells which communicate freely with each other wherever they are found, a conspicuous proof of which is afforded in disease.

In its natural state it is highly elastic; and, if drawn out to any extent, it suddenly recoils, which shews its structure highly condensed and compacted.

CCXL.

The extent of this membrane is greater than that of any other part. It first lines the skin; it next covers the muscles; it then enters between their fibres; and lastly, it forms part of their composition. It varies, however, in its thickness in different parts of the body, especially where there is much exposure to pressure; as in the hips, palms, and soles, and there it is always thickest.

CCXLI.

The cells of this membrane are kept moist by an interstitial fluid, and in many parts they sustain the fat, or the vesicles containing it are deposited in them. On the whole, it possesses little share of sensibility, and discovers on injury little irritability or pain. Its chief use seems to be to connect parts together to prevent their morbid adhesion to each other, to form their covering and sheath to move in, and to serve as a depository for the organs secreting the fat.

CXLII.

*Fat (Adeps).*

The opening of the cellular membrane leads next to the examination of the fat. This substance



is lodged in it, but without any proper communication with it. It is made up of masses composed of small vesicles containing it. These vesicles are surrounded by a network of blood vessels which secrete the fat, without any glandular structure; and this fat transudes from the cells without any communication between the vesicles with each other, or with the excretory ducts to convey it.

## CCXLIII.

The fat shews considerable difference in its consistence in different parts of the body. In the living animal it is generally fluid, though in some parts it is more solid, and in the same state as it displays after death. The fullness and size of the body are in a proportion to the presence of the fat; and it is deposited in almost every part of the system, external as well as internal: but in young persons it is for the most part placed externally, while in the aged it is removed to the internal parts, and deposited on the viscera.

## CCXLIV.

The uses of the fat are numerous. It particularly serves to lubricate every part; to facilitate the action of the muscles; to give form, smoothness, and plumpness, when required; to obviate the effects of pressure; and to be ready as a reservoir of nourishment, when needed under disease.

*Chemical Analysis of the Common Teguments and their Appendages.*

1. The cuticle, when submitted to chemical investigation, is chiefly composed of gelatin. The rete mucosum in its consistence is glutinous, and without taste or smell. In colour it varies from the three causes of climate, part of the body, and disease. The first was already noticed in its description. The second is conspicuous in the areolæ of the nipples; and the third in jaundice, chlorosis, and other diseases. The constituent principles of this part are animal mucus, mixt with the colouring principle.

2. The true skin, in consequence of the different experiments of chemists, is found to be simply gelatin, with an additional quantity of oxygen.

3. The nails, when boiled, give out jelly and a small portion of oil, but they contain no earth, some gluten, and a little phosphorated calx.

4. The hairs give out the same principles as the nails, animal jelly, and a small portion of oil without any earth.

5. The sebaceous follicles and miliary glands, are most remarkable for their secretion, which is somewhat oleaginous, and most conspicuous under the arm-pit. It is of a pale colour, reddish in the axillæ, and blackish between the toes. It stains the clothes frequently of a blue colour, and is converted into a red by the juice of lemons.

6. The fat is fluid in the living body, has a hard, soft, and oleous taste. Though in various proportions, it is never less at a medium than 8lbs. in one person;

but from mode of life and constitution, it is often accumulated to an enormous degree. Its constituent principles are oil chemically combined with sebacic acid, and the elements of this last are, oxygen, united with an unknown acidifiable base.

*Anatomical Preparation of Teguments.*

7. The skin is prepared in the same manner as the periosteum of the bones, and may be formed either into a wet or dry preparation. When put into water, it should remain in maceration till the cuticle peel easily off; by the removal of which, its vascularity will be beautifully exhibited.

CCXLV.

*The Muscles.*

On removing the skin and adipous membrane, the muscles come into view, or the organs by which the motions of the animal machine are produced.

CCXLVI.

These motions depend on a certain inherent power of the muscular fibre peculiar to itself, and which gives it the distinguishing character of contractility.

CCXLVII.

To explain this power, various attempts have been made by anatomists; some conceiving it to depend on the size, others on the form of the muscular fibre; but these explanations proving still unsatisfactory, reason has drawn us to this ultimate and more just conclusion, that it is a





power originally attached to the muscular fibre, and connected alone with this form of organization, in a manner not to be ascertained. Its existence, therefore, as the source of motion and life, we have only to trace. •

## CCXLVIII.

This existence we are to consider as confined entirely to the muscle itself, and as no way conveyed from it to the sensorium; that it is the power by which the muscles themselves feel and react, without any connection or communication with the rest of the system.

## CCXLIX.

To this power, the name of irritability has been assigned, and in proof of its independence, it is seen to exist when muscles are separated from every other part of the body, and when the latter is to all appearance dead. The separation therefore of the nerves of a muscle no way affects its contractility. Its contractility is no way connected with its feeling, and can be put in action when its feeling is entirely gone. Thus the power of muscles survives life, while feeling terminates with life, and it also survives connexion with the rest of the body:—facts, which strongly mark it as a peculiar and independent property of this form of organization.

## CCL.

By this power, the parts are preserved ready for the action of such stimuli as may be applied to them; and, while the nerves convey the impression, the muscles contain the power by which this impression is put into effect. The nervous energy becomes exhausted or diminished; but the power of the muscles remains always the same, and suffers no decay. Sensibility then is dependent on the nerves and motion on the muscles.

## CCLI.

The power of the muscles also requires no need of mechanical aid in the performance of its motions; for they can be exerted in a degree suited to the force or energy, which the actions of the body require. Hence, the mechanical aid arising from the form or construction of muscles, is never to be taken into account; for the form of different parts of the body is generally in opposition to this circumstance, and yet the power of the muscle is sufficient to perform the particular function assigned it.

## CCLII.

In the construction of the human system, the vital energy predominates an energy no way subjected to the laws of inanimate matter; but which must be considered as a peculiar agent, whose operation regulates every part of the system in which it is implanted; and which is modified ac-

according to the nature of each particular part, or the purposes for which it is intended.

## CCLIII.

The muscles being intended for motion, this modification of the vital principle they receive, is termed, as already noticed, their irritability. They are composed of fleshy fibres or threads in which it resides, and each muscle is divided into a body and two extremities. The extremities are generally formed into a firm, glistening, and insensible substance of a white colour; when round and slender, named tendon, and aponeurosis, when broad, flat, and expanded. By this change of structure, the muscle is condensed into less form, and thus room is given for its complete attachment to the fixed parts that receive it. These extremities of a muscle are distinguished into its head or origin, and its tail or insertion, though this distinction is not always properly made. The first is considered as the fixed or immoveable point, the second as the loose one, to the alteration or movement of which the action of the muscle tends. To allow again the general body or belly of the muscle to play with ease, there is a thick coat over it of cellular substance, which condensed, gives the appearance of what has been termed the proper membrane or coat of the muscles; (*Membrana Propria Muscularum*;) and, as every fibre of the muscle is active, and as the fibres are not only



swelled out, but they are thrown into a zig zag form; to allow of this action, the cellular substance dips in between all the fibres of our body.

## CCLIV.

The action of every muscle depends on the length of its fibre, and the extent of its motion corresponds to this. Various have been the opinions on the structure of these fibres. We find them by the eye disposed in fasciculi or bundles, and these subdivided into smaller ones; but farther we cannot go in our research into their intimate structure, neither is it of any importance.

## CCLV.

Many arrangements of the muscles have been made by authors. The simplest and easiest is that which demonstrates them according to their situation, beginning in the order of the osteology, and considering them as cords attached to the bones to effect their movement. On this plan we first demonstrate the

## CCLVI.

## MUSCLES OF THE HEAD.

1. *Occipito Frontalis.*

The *ist* that falls to be described, and which covers the upper part of the head with a broad thin expansion, is named the occipito frontalis, having two bellies divided by intermediate tendon,

firmly attached to the skin; so that the one belly is spread over the forehead, and the other over the hindhead. This division has caused it to be mistaken for two separate muscles, and its tendon for part of the pericranium. In demonstrating it particularly, we observe,

1. The origin or fixt point of this muscle is placed at the upper ridge of the occipital bone, covering all the back part of the head from the mastoid process on one side, to the same place on the other.

2. The insertion of this muscle is into the skin and eyebrows, after covering by its frontal belly the forehead. It possesses also some slight attachment to the bone at the orbitary ridge, inner corner of the eye, and root of the nose.

3. The use of this muscle is to move all that part of the skin which covers it, consequently to raise the eyebrows, wrinkle the forehead, &c. Thus it is a muscle chiefly employed in expressing the passions, and in many subjects it is entirely wanting.

4. Its nasal slip, or continuation on the nose, being inserted into the nasal bone, must serve to pull the eyebrow downwards, or to antagonize the other parts of the muscle.

## CCLVII.

### 2. *Corrugator Supercilii.*

The corrugator supercilii is a small muscle or

flip, which, though connected somewhat with the occipito frontalis, is generally described separate. It arises from the internal angular process of the frontal bone, its fibres sweep round the edge of the orbit, and in their progress become mixed with those of the frontal and orbicular muscles, being inserted where these two join each other, or into the eyebrow. Thus, by its action, it assists in drawing the eyebrows together, and in corrugating or wrinkling the skin between them into longitudinal folds.

## CCLVIII.

3. *Orbicularis Oculi* or *Palpebrarum*.

The orbicularis oculi is a muscle that surrounds the eyelids in a circular form, of a flat thin appearance, and about an inch in breadth. Its situation is immediately under the skin of the eyelid, to which it is more connected than to the bone. Its origin is from the orbital process of the superior maxillary bone, from the internal angular process of the frontal bone, and by a small round tendon from the nasal process of the superior maxillary bone, which tendon is easily felt through the skin, in the inner corner of the eye externally; the surface of the muscle adheres to the eyelids, and on its upper and inner edge, it is connected with the frontal and corrugator muscles. It forms in its whole course a thin muscular expansion, varying in its breadth at different places; and where its fibres cross each

other from the upper and lower part, it has been divided into two muscles, that part which is next to the cartilaginous circle of the eyelids being named the ciliary muscle. The action of this muscle from its circular form, is to bring the eyelids together, to press the ball inwards, which it does even with violence in cases of injury, and to force the lacrymal gland within the socket to a discharge of tears.

## CCLIX.

4. *Levator Palpebra Superioris.*

This small muscle arises from the hole which gives passage to the optic nerve. In its course it runs forward within the orbit over the levator oculi, beginning by a small flat tendon in the bottom of the optic cavity, and expanding as it proceeds over the eyeball, till it terminates in the lid.

## CCLX.

Thus, in commenting on the muscles described, we observe that the occipito frontalis raises the eyebrows, which are again pulled down by its pointed slip. That the corrugator draws them directly inwards; and, that it also knits the brow, while the levator opens the eye, which is again fully closed by the orbicular muscle.

## CCLXI.

## - MUSCLES OF THE NOSE AND MOUTH.

5. *Levator Labii Superioris et Ala Nasi.*

This muscle arises by two thin slips, or a double

tendon from the nasal process of the upper jaw-bone. In its progress it divides into two parts, one of which is inserted into the cartilaginous wing of the nose, and the other passes on to the upper lip. Its action is to raise the upper lip, and draw it and the skin of the nose upwards and outwards. Thus it serves to dilate the nostril.

## CCLXII.

6. *Levator Labij Inferioris Proprius.*

This muscle is termed also the incisivus, in consequence of its origin from the upper jaw, immediately above the incisors or cutting teeth, where it is broad. Its progress downwards is oblique and inwards, terminating in the middle of the lip. Its action is to pull the lip and septum of the nose upwards.

## CCLXIII.

7. *Levator Anguli Oris.*

This muscle, termed also caninus, arises immediately under the superior maxillary bone, between the orbital hole and the first molar tooth. It is inserted into the orbicular muscle of the mouth at its angle, and its action is to raise the corner of the mouth, as in expressing the chearful passions.

## CCLXIV.

8. *Zygomaticus Major.*

This muscle agrees with the former, both in its direction and use. Its origin is the cheek-bone

## AND DISSECTION. . clxxxiii

near the zygomatic future, whence it descends obliquely forwards, till inserted in the angle of the mouth. Its action is to inflate the cheek, and raise the angle of the mouth. Its fibres are intermixed with those of the orbicularis of the mouth, and the depressor of the lip.

### CCLXV.

#### 9. *Zygomaticus Minor.*

In its origin, this muscle is nearer the nose, and is more slender than the former. It is inserted also into the angle of the mouth, and its action is to raise it obliquely outwards.

### CCLXVI.

By the zygomatic muscle, is that line formed which is so conspicuous in many, and extends from the cheek-bone to the corner of the mouth. To pull the corners of the mouth upwards is its action; and thus, from occasioning distortion of this part, it is employed in expressing several passions, as laughter, rage, grinning.

### CCLXVII.

#### 10. *Buccinator.*

The trumpet muscle is of such a size, as to form the walls of the cheek. It arises from the sockets of the molar teeth in both jaws, and it advances with direct fibres to be inserted into the corner of the mouth, along with the orbicularis. This muscle is perforated in the middle by the

duct of the parotid gland. Its uses are to draw the angle of the mouth backwards and outwards; and to contract its cavity by pressing the cheek inwards. Thus it assists in swallowing, particularly liquids. It prevents also the food in the mouth from getting beyond the line of the teeth in manducation. In the blowing of wind instruments it is active, and has therefore received its name from blowing the trumpet.

## CCLXVIII.

11. *Depressor Anguli Oris.*

This is a triangular muscle at the side of the chin, arising from the lower edge of the inferior jaw-bone, where its base is placed. It passes on with a flat fleshy head, an inch in breadth; and is inserted into the angle of the mouth, intermixing with the levator anguli oris. Its action is chiefly employed in expressing the passions, and in giving form to the chin and mouth. In the angry passions it depresses the corner of the mouth.

## CCLXIX.

12. *Depressor Labii Inferioris.*

This is a small square muscle, situated on each side of the chin, and arising from the lower and anterior edge of the maxilla inferior. It passes obliquely upwards and inwards, and is inserted into the under lip. Its action is to draw the under lip downwards, and somewhat outwards.

## CCLXX.

13. *Orbicularis Oris*

Is a regular muscle, forming the sphincter of the mouth, and in breadth constituting the thickness of the lips. From its crossing at the angles of the mouth, it has been considered often as two semi-circular muscles, in the same manner as the orbicularis of the eye. Its fixed points are the angles of the mouth, and its action is to contract or shut the mouth, and to antagonize the other muscles described. A small slip often runs up from it, from the middle of the upper lip to the tip of the nose; serving as a levator of the former, and depressor of the latter.

## CCLXXI.

The offices which the muscles of the nose and lips perform, are various and important. They are necessary to the performance of the great functions of breathing, speaking, and the other offices of the mouth; and they likewise serve to express the different passions. Thus, in attending to their separate operation, we observe that the levator labii superioris, and the depressor labii inferioris, by separating the lips, open the mouth; while the levator anguli oris, and the zygomatic muscles raise the cheeks, and dilate the corners of the mouth. The buccinator opens the mouth in consequence of drawing it directly backwards.



The angularis oris pulls the angles of the mouth downwards and backwards ; thus forming it into a circle, and dilating it. But all these muscles are opposed by the orbicularis, which shuts the mouth, and that so completely, as to retain the breath against every exertion. Underneath the muscles demonstrated, some smaller ones still remain proper to these parts.

The 1<sup>st</sup> of them is

### CCLXXII.

#### 14. *Depressor Labii Superioris et Alae Nasi,*

A small fleshy muscle, which arises from the gum or socket of the fore teeth of the upper jaw, and is inserted into the upper lip and root of the ala nasi. Its action is to pull the upper lip down,

### CCLXXIII.

#### 15. *Constrictor Nasi*

Is a scattered bundle of muscular fibres, which crosses the wings, and goes to the point of the nose. It is fixed with its fellow in the middle cartilage or lower point of the nasal bones. Its use is to press the ala, as in snelling, towards the septum. It also corrugates the skin of the nose.

### CCLXXIV.

#### 16. *Levator Mentis.*

This muscle arises at the root of the cutting teeth, and is inserted into the skin on the very

centre of the chin. By its action, the skin is drawn into a dimple, and it stretches the under lip at the same time.

## CCLXXV.

*Muscles of the Ear.*

The external ear possesses rarely any motion in the human subject, in which it differs from animals. A slight degree of motion, however, has been observed in some particular instances. The muscles which belong to this organ are numerous.

## CCLXXVI.

17. *Superior Auris.*

The first is the *attollens aurem*, so termed from its action in raising the ear. It is a thin flat expansion, covering the aponeurosis of the temporal muscle; from its origin it becomes gradually narrower to its insertion in the root of the cartilage of the ear. It is, perhaps, more intended to give tension to the part to which it is united, than to raise the ear.

## CCLXXVII.

18. *Anterior Auris*

Is a thin membranous expansion near the posterior part of the zygoma, which is inserted near the cartilaginous tube, at its root. Its use is to stretch this part of the ear to which it is fixed.

## CCLXXVIII.

19. *Posterior Auris*

Is a small delicate muscle, which arises in three

narrow slips from the situation of the mastoid process; and passing forwards, they are inserted directly into the bony part of the concha. By their action, this part is stretched; and the ear in some persons also drawn back, on which account it is frequently named the *retrahens auris*.

After these external muscles, follow in their order the muscles proper to the ear itself, which are :

### CCLXXIX.

#### 20. *Musculus Helicis Major.*

This muscle lies upon the upper and sharp point of the outward ring; and its action is to pull that part into which it is inserted, downwards and forwards.

### CCLXXX.

#### 21. *Musculus Helicis Minor.*

This is placed also upon the helix, but lower in its situation.

### CCLXXXI.

#### 22. *Musculus Tragicus.*

This muscle lies upon the concha, and stretches to the tragus; the point of which falls a little forwards.

### CCLXXXII.

#### 23. *Musculus Antitragicus.*

This muscle is situated in the antitragus, and is meant to turn the tip of the antitragus a little outwards.

## CCLXXXIII.

24. *Transversus.*

This last muscle arises from the prominent part of the concha, and is inserted into the outside of the antihelix. Its use is to draw the parts to which it is connected towards each other.

## CCLXXXIV.

*Muscles of the Eye Ball.*

The ball of the eye, is necessarily surrounded from its function with muscles, so that it may be easily moved in every direction. These muscles are divided according to their direction into four straight, and two oblique muscles. They arise very deep from the bottom of the socket. They are expanded on the ball of the eye, and fixed or united to its forepart in the form of colourless tendons spread out, so as to form the white of the eye. The straight muscles are situated one above, one below, and one on each side; and their action is to pull from the bottom of the socket. The oblique muscles again act, by pulling from the edges of the socket, and turn the eye directly the reverse of the straight muscles. The straight muscles are not just what the name implies, as on account of the situation of the eye and the shape of the orbit, they do not run in a straight direction. Neither are they all equally long, the internal being the shortest, the external the longest, and the other two nearly of the same

length. They all agree, in this, that they arise by a small narrow beginning, tendinous and fleshy from the edge of the optic hole, where they surround the nerve completely, and adhere to it. In their progress they gradually expand into a fleshy belly, which sends off broad and very thin tendons to be inserted into a separate coat; and thus they form the white of the eye. In their course also, they are covered with a cellular sheath, which comes to terminate in that covering that is interposed between the sclerotica and conjunctiva.

## CCLXXXV.

25. *Rectus Superior.*

The 1<sup>st</sup> of the straight muscles is the rectus superior, termed also the attollens, the levator oculi, and superbus. The two first, from its use to raise the forepart of the ball of the eye; the last, from its being employed to express haughtiness and pride.

## CCLXXXVI.

26. *Rectus Inferior.*

This muscle is the opposite of the former, and is therefore termed the depressor oculi or humilis, as expressive of modesty and submission, by pulling the eye downwards.

## CCLXXXVII.

27. *Rectus Internus.*

The action of this muscle is to turn the forepart of the eye towards the nose. Hence it is

termed adducens, and also bitorius, from its carrying the eye towards the cup.

## CCLXXXVIII.

28. *Rectus Externus.*

This muscle directs the eye towards the temple, or turns it away as in anger and scorn; therefore named the abducens and indignabundus.

By the successive action of these muscles described, the eye comes to be rolled. Acting again, at once they immoveably fix it.

From the straight, we come next to the consideration of the oblique muscles.

## CCLXXXIX.

29. *Obliquus Superior.*

The first of them, the obliquus superior, like the straight muscles, arises from the edge of the optic hole on the inner side; and running straight forward, sends off a long round tendon which passes through a cartilaginous pulley, fixed behind the internal angular process of the frontal bone. This pulley projects farther than the most prominent part of the eye ball; and the tendon is inserted into the sclerotic coat, half way between the insertion of the levator oculi, and entrance of the optic nerve. The action of this muscle is, to turn the pupil of the eye downwards and outwards.

CCXC.

30. *Obliquas Inferior.*

This muscle arises from the nasal process of the jaw-bone in the lower edge of the orbit at the inner corner of the eye; from which it passes obliquely outwards, backwards, and upwards, round the ball of the eye. It is inserted by a broad thin tendon into the sclerotic coat, opposite to the insertion of the superior one; and its use is to turn the eye upwards and inwards.

CCXCI.

These oblique muscles, from their action in rolling the eye, have been named *rotatores* and *amatorii*. They bring the eye ball forward in the socket when their action is conjoined. When separate, the upper oblique rolls the eye so as to turn the pupil downwards towards the nose; while the lower oblique reverses this, and directs it upwards and outwards.

CCXCII.

*Muscles of the Lower Jaw.*

Having demonstrated the muscles of the head, face, ear, and eye, we proceed to those of the lower jaw, they are of great power, which they necessarily require in the manducation of the food.

CCXCIII.

31. *Temporal Muscle.*

The first of these muscles is the temporal one,

which arises in that hollow behind the eye, from all the bones which have a share in forming the squamous future. It arises also from the strong membrane extended from the jugum to the semicircular ridge of the parietal bone. Its fibres descend like radii, and it changes into tendon as it passes under the jugum, till it is inserted into the coronoid process of the lower jaw, which it encloses. By its action it pulls the jaw upwards and backwards.

## CCXCIV.

32. *Masseter.*

The rounding of the cheek, at its back part, is formed by this thick fleshy muscle, which arises from the superior maxillary bone, where it joins the os male, and from the whole length of the inner and under edge of the zygoma. It lies in the outside of the coronoid process, covering the branch of the jaw quite down to its angle. The parotid gland lies in its upper part, and its duct lies over this muscle as it crosses the cheek. With the former muscle it pulls up the jaw.

## CCXCV.

33. *Pterygoid Muscles.*

The two pterygoid muscles on each side, are so named from the pterygoid process of the sphenoid bone, from which they arise. The internal one is that one which arises from the internal pterygoid process, and which passes to the angle of the



jaw on its inside. The external one arises from the external process, and goes directly outwards, being inserted high up in the jaw bone. The action of the first is to raise the jaw, and draw it obliquely towards the opposite side. The action of the second is to pull the jaw from side to side.

## CCXCVI.

Thus, in attending to the motion of the lower jaw, we find that the temporal muscle acts like a lever upon the coronoid process; the masseter does the same upon the angle, while the internal pterygoid balances the masseter within, and the jaw is by this means pulled strongly upwards for its different offices. The internal pterygoid draws it again from side to side, or produces that rotation which is essential for the purposes of chewing and grinding.

## CCXCVII.

In considering the muscles of the face, we observe that those of the lips perform a double office; for, besides their common motions, they serve likewise to explain to one another our intentions, or express our passions in a manner readily understood, but difficult to be described; and that arising from original texture. As a proof of this, we find in children the expression very much varied, and that this variety is by no means to be attributed to habit. Indeed, the disposition of the muscular fibres would seem purposely varied in

different persons; for we do not find that any two descriptions of the most accurate anatomists agree, and we frequently find in the face *lusus naturæ*. That habit, however, has the power of giving one kind of expression more strongly marked, is beyond a doubt. Thus we see persons of the same profession, and who are used to direct their attention to particular objects, have the same resemblance in their countenance.

## CCXCVIII.

## MUSCLES OF THE THROAT AND TONGUE.

*Os Hyoides.*

As introductory to this part, the bones and cartilages which form the throat require to be demonstrated. These are the *os hyoides* and its appendages.

The *os hyoides* is a small bone situated at the root of the tongue and top of the larynx, where it is placed to allow the insertion of several muscles into it, and where it serves for them as a lever or fixed point. In its shape this bone resembles the Greek letter  $\nu$ , being convex before, and concave behind. Its thick or middle part is named its basis, and may be felt outwardly. The situation of this bone is an inch below the chin. It sends out two horn-like processes, which go backwards along the sides of the throat, and are termed its horns. These are tied by a strong ligament from

the styloid process of the temporal bone, and these horns again are united to its basis by small cartilaginous pieces, which are often converted into bones. Two small processes stand up from the gristly part of the bone at the joining of the horns, and are termed its upper ones. By the basis of this bone is formed the root of the tongue and top of the larynx, with the epiglottis situated upon it, near that valve which regulates the opening of the windpipe. By its horns, the opening of the wind-pipe and gullet are preserved extended, as it passes along the sides of the throat. Hence it forms the centre of all the motions of these parts. To it the muscles are appended which either raise or depress the throat, or move the tongue, and it connects them all together.

## CCXCIX.

The trachea, or wind-pipe, is the passage to the lungs, at the top of which is placed the larynx, or principal organ of the voice, immediately under the os hyoides. It is composed of a variety of parts, the principal of these are its cartilages, on which the modulation of the voice depends. These cartilages are five in number. The first is the scutiform or thyroid, and is placed at its upper and forepart, meeting on each side like flood-gates, being the largest of the whole. The place of this meeting is easily felt externally in the middle of the throat, and it forms that tumor known

by the name of the *Pomum Adami*. The upper part, where the sides of the thyroid cartilage unite, is formed into a notch; from which, and from the upper edge in general, ascends a broad ligament to fix it to the under part of the *os hyoides*. From the posterior corners, four processes project, termed its horns; two of which, the superior ones, ascend to be joined by round ligaments to the extremities of the horns of the *os hyoides*. The inferior horns are curved backwards, and fixed to the sides of the cricoid cartilage.

## CCC.

The cricoid cartilage, the next in order, lies below the thyroid. It is named from its resemblance to a ring or hoop, and may be also readily felt in the forepart of the throat. It is narrow before, and thick, broad, and strong behind. It forms the top ring of the trachea, and the lower ring of the larynx; and upon both parts are seated two small cartilages, which form the opening for the breath.

## CCCI.

The two arytenoid cartilages are named from their resemblance to a drinking glass. They are two small bodies of the size of peas, and in their form somewhat triangular; the base of which is placed upon the upper and posterior edge of the cricoid cartilage, with the point a little crooked

and hook-like directly upwards. In this form they compose an opening somewhat like a trouped basin, which opening assumes a proper rounded appearance, when they are covered with the thick membrane of the throat, interspersed with mucous glands. This opening is named the rima glottidis, and the cartilage forming it being fixed as a hinge, they both form and modulate the voice in consequence of their motions.

CCCII.

The epiglottis is a broad triangular cartilage, very elastic, and intended to defend the opening of the glottis. It is fixed at once to the os hyoides, to the thyroid cartilage, and to the root of the tongue, and it hangs backwards over the opening of the chink of the glottis, and may be seen and examined by pressing down the root of the tongue. It is suspended by small peaks of membrane, called ligaments; and it is raised and depressed by various muscles.

CCCIII.

Such is the form of the larynx. Composed of hard cartilage, it resists compression; and peculiar in the form of its opening, it composes and modulates the voice. Before, the opening of the larynx is defended by the thyroid cartilage, which goes also far backwards. The arytenoid cartilages are supported by the cricoid, which raises them by its deepness behind, and then occasions the

opening of the glottis to be well defended by the thyroid cartilage. The arytenoid cartilages form the opening or chink on which the power of voice, its various modulations and tones, depend. These cartilages require often the nicest regulation and movement of their muscles; while the epiglottis or valve protects this part from injury, by flapping on the smallest irritation, and preventing it having access to its cavity. With this introduction the use of the muscles of these parts will be understood.

## CCCIV.

*Muscles of the Throat.*

The muscles of the throat are divided into those which pull it down, and those that draw it upwards.

## CCCV.

*Sterno-Hyoidens.*

Of the former, the first is the sterno-hyoidens, which passes from the sternum to the os hyoides. In its form it is a uniform, flat, smooth, fleshy muscle, arising from the upper and inner part of the sternum, and inserted into the base of the os hyoides.

## CCCVI.

*Sterno-Thyroideus.*

This muscle passes from the sternum to the thyroid cartilage; and is, like the former, uniform, smooth, thick, and fleshy. It arises from the

upper and inner part of the sternum, and partly from the cartilage of the first rib. It runs along the forepart and sides of the trachea and thyroid gland, and it is implanted into the under and lateral part of the thyroid cartilage. Its action is to draw the larynx downwards.

## CCCVII.

*Omo-Hyoideus.*

This is a muscle

... muscle of great length, and very slender, reaching from the shoulder to the os hyoides. It is flat and fleshy, though not so broad as the two former. It lies along the side of the neck, and has its belly divided at the middle by a cross tendon, which forms it into two heads. It arises from the superior notch of the scapula, and is inserted into the base of the os hyoides, at the side of the first muscle.

## CCCVIII.

By the action of these three muscles is the throat pulled down. By the two former this is performed in a direct manner, by the last it is drawn to one side, though by the concurring action of both, it is equally direct.

## CCCIX.

The muscles which elevate the throat follow next. These are,

*Mylo-Hyoideus.*

First, the mylo-hyoideus, which arises from the inside of the lower jaw, or from the backmost

molaris to the point of the chin, where it joins its fellow. It is inserted into the body of the os hyoides, and it is joined to its fellow by a white tendinous line. Its action is to pull the os hyoides both upwards, forwards, and to a side.

## CCCX.

*Genio-Hyoideus.*

This muscle arises from the chin at a rough point or tubercle at the inner side of its symphysis. Its beginning is exceedingly narrow; as it proceeds downwards, it grows broad and flat, and is inserted into the bone of the os hyoides by a broad edge. Its action is to draw the os hyoides towards the chin when the jaws are shut, or the chin towards the os hyoides, when the latter is fixed by the muscles coming from the sternum. The sublingual gland lies flat betwixt this muscle and the last.

## CCCXI.

*Stylo-Hyoideus.*

This muscle begins from about the middle of the styloid process, and passing obliquely downwards and forwards, is fixed at that part of the os hyoides, where its base and horn are joined. Its fibres split above its insertion, so as to allow the digastric muscle to pass.

This muscle is often attended by another small muscle of the same name, but it is more slender.



When it is found, its origin, insertion, and action are the same.

## CCCXII.

*Digastricus or Biventer Maxillæ Inferioris.*

This muscle is named from its double belly. It arises from a groove at the root of the mastoid process. It goes obliquely forwards and downwards, and forms a large round tendon, which is fixed by a ligament to the os hyoides; after which it runs obliquely upwards and forwards, and is inserted at last into the bones and anterior part of the chin. Its action is to open the mouth, by pulling the lower jaw downwards and backwards; and when the jaws are shut, to raise the os hyoides, and of course the throat, as in swallowing. Hence it is properly a muscle of the throat.

## CCCXIII.

The next muscles that fall to be demonstrated, are those that move the parts of the larynx on each other; and the first of them is the

## CCCXIV.

*Hyo-Thyroideus.*

This fleshy short muscle extends from the os hyoides to the thyroid cartilage. It arises from part of the base and horn of the os hyoides, and is inserted into a rough oblique line at the side of the cartilage. Its use is to raise the thyroid cartilage, or depress the os hyoides.

## CCCXV.

*Crico-Thyroideus.*

This muscle is very short. It arises from the side and forepart of the cricoid cartilage, and is inserted by two portions, one into the lower edge of the thyroid cartilage, and the other into its inferior horn, by which means it is a little pointed below. The use of this muscle is to pull the cricoid cartilage upwards and backwards, or the thyroid forwards and downwards; and thus by shortening the trachea, or compressing it slightly, in must affect the voice.

## CCCXVI.

The muscles of the voice are chiefly those of the arytenoid cartilages, and which consequently act by opening and shutting the rima glottidis. The first of these is the

## CCCXVII.

*Musculus Arytenoideus Transversus.*

This muscle lies across betwixt the arytenoid cartilages at their back part. It arises from the whole length of one, to be inserted into the whole length of the other. Its use is to draw the cartilages towards each other, and thus to clear the glottis.

## CCCXVIII.

*Arytenoideus Obliquus*

Crosses the other obliquely. It arises at the root of each arytenoid cartilage, and passes ob-

liquely to the extremity of the opposite one. By the action of this muscle and its fellow, the aperture of the glottis is closed.

## CCCXIX.

*Crico-Arytenoideus Posticus.*

This muscle arises broad and fleshy from the back part of the cricoid cartilage. It is of a pyramidal form, and is implanted by a narrow point into the back of the arytenoid cartilage. Its use is, by pulling the arytenoid cartilage directly backwards, to lengthen the opening of the glottis.

## CCCXX.

*Crico-Arytenoideus Obliquus.*

The origin of this muscle is from the side of the cricoid cartilage, where it is covered by the thyroid, and it is inserted into the sides of the arytenoid cartilage near its base. Its use, therefore, is to open the glottis by separating the arytenoid cartilages, and with them the ligaments of the glottis, which are two cords that go within the covering from the tip of each cartilage to the back of the thyroid one; and while the former muscle strengthens these cords, the present will of course relax them.

## CCCXXI.

*Thyrio-Arytenoideus.*

This muscle is an assistant to the last. It arises from the back surface of the side of the thyroid

cartilage, and is inserted into the forepart of the arytenoid cartilage. By pulling the cartilage forward and sideways, it directly slackens the ligaments and opens the glottis.

## CCCXXII.

Such are the several muscles of the larynx, while those of the pharynx follow next in the arrangement; and in entering upon them, we observe that in swallowing, the velum palati is drawn up and dilated as a preparatory step; when it passes it, it again falls down, the opening of the throat is contracted, a compression of the pharynx takes place, and the food is forced into the stomach.

## CCCXXIII.

*Azygos Uvulae.*

The azygos uvulae is a small slip of straight fibres, which goes directly down to the uvula or point, in the centre of the pendulous curtain it seen hanging in the back part of the mouth. This muscle arises from a sharp point of the palate bones, and pulls the uvula directly upwards, so as to allow, by its action, any substance introduced into the mouth to pass.

## CCCXXIV.

*Levator Palati Mollis.*

This muscle arises from the point of the pars petrosa of the temporal bone, and from the eustachian tube and sphenoid bone, and it is inserted

by a broad expansion into the velum on which it is spread. By its action, the velum is pulled up or raised in the time of swallowing, and pressed against the nose, which prevents the food or drink from passing that way.

## CCCXXV.

*Circumflexus Palati*

Arises from the spinous process of the sphenoid bone, and the beginning of the eustachian tube, along which it runs down betwixt the pterygoid processes. It then becomes tendinous, and turning under the hook of the internal pterygoid process, it mounts again to the side of the velum. The use of this muscle is to pull down the palate, and stretch it.

## CCCXXVI.

*Constrictor Isthmi Faucium.*

The origin of this muscle is from the root of the tongue at the side, and it runs in the doubling of the skin which forms the anterior arch of the palate, being inserted into the middle of the velum at the base of the uvula. By its action, the palate and root of the tongue are drawn to each other, and the opening of the throat thereby shut.

## CCCXXVII.

*Palato-Pharyngeus.*

The fibres of this muscle run within the posterior arch of the palate, and pass to the upper

and lateral part of the pharynx. Its origin is from the middle of the velum, and it becomes implanted into the upper and back parts of the thyroid cartilage. Its use is to contract the arch of the fauces, by drawing the velum and uvula downwards, and to assist in conveying the food into the pharynx.

## CCCXXVIII.

Before going farther in the description of its muscles, it is proper to demonstrate the pharynx itself. This part, or opening into the gullet, forms a large and capacious cavity. It depends from the base of the skull, being fixed to the occipital bone, the pterygoid processes, and back parts of both jaws. It terminates in the œsophagus or canal to the stomach, and forms as it were its mouth or funnel. Towards the mouth it is bounded by the base of the tongue and arches of the throat; behind it lies smooth on the vertebræ, and before it is environed by different parts of the larynx, which cover it with flat muscular fibres, and serve as constrictors to it when contracted.

## CCCXXIX.

*Stylo-Pharyngeus.*

This muscle is a beautiful fleshy expansion on the side of the pharynx. It arises from the root of the styloid process, and is inserted into the edge of the thyroid cartilage. By its action the pharynx is first raised and dilated, and then its

top straitened and compressed to push the substance down.

## CCCXXX.

The other muscles of the pharynx ought to be properly considered as one. They consist of the circular fibres which surround it, and serve as constrictors when in action. Their various origins, however, occasion their being demonstrated as distinct parts.

## CCCXXXI.

*Constrictor Superior.*

The first is named the constrictor superior. It arises from the cuneiform process of the occipital bone, from the pterygoid process of the sphenoid, and from each jaw near the last molaris. It surrounds the upper part of the pharynx, divided in the middle by a seam. By its action, the upper part of the pharynx is compressed for the purpose of thrusting down the food.

## CCCXXXII.

*Constrictor Medius.*

This compression is farther assisted in the middle by the next muscle which arises from the horn and appendix of the os hyoides, and also from the ligament which unites it with the thyroid cartilage. In its progress it goes upwards to touch the occipital bone, and downwards upon the next muscle, by which it is hid in part.

## CCCXXXIII.

*Constrictor Inferior.*

This muscle arises from the cricoid and thyroid cartilages, and is divided by a tendinous middle line. Its use is the same as the others, to assist in compressing the part, and pushing down whatever is introduced into the pharynx.

## CCCXXXIV.

The last part, or œsophagus, is a simple continuation of the pharyngeal tube, lying flat on the back bone, and covered for its whole length with straight muscular fibres, different from the circular ones of the pharynx. From the manner in which these fibres are placed, they receive the name of the Sheath, or Vaginalis Gulæ.

## CCCXXXV.

*Muscles of the Tongue.*

The tongue is almost entirely composed of muscles, which form its thickness, and enable it to perform all its motions. These muscles arise from the os hyoides, the chin, and the styloid process. Except its membranes, then, and its papillæ, the tongue is wholly muscular.

## CCCXXXVI.

*Stylo-Glossus.*

The first of its muscles is the stylo-glossus, so named from its origin from the styloid process. Its course is obliquely downwards and forwards,



so that it forms part of the side of the tongue, and it spreads out its fibres in radii. Its use is to move the tongue backwards, or into the mouth, and to one side.

## CCCXXXVII.

*Hyo-Glossus.*

This muscle is all that flesh that arises from the length of the os hyoides, which is divided by the changing form of the bone, and this division rendered it formerly distinguished into different muscles, under the names of the basio glossus, chondro glossus, and cerato glossus. Its action is to depress the edges of the tongue, and thereby to render its upper surface convex.

## CCCXXXVIII.

*Genio-Glossus.*

This muscle has a narrow origin, but spreads out in the manner of a fan as it proceeds to the tongue, of which it forms the chief part, as its fibres stretch out in radii, and are directed both forwards and backwards. It arises from the rough tubercle behind the joining of the chin, and it is inserted into the whole length of the tongue, and base of the os hyoides. Its action serves to move the tongue in various directions.

## CCCXXXIX.

*Lingualis.*

The last muscle is an irregular bundle of fibres

extending the length of the tongue, and arising laterally from its root. In its progress it advances between the two former, and is inserted into the tip. By its motion, the point of the tongue is raised, its length shortened, and it is drawn backwards.

## CCCXL.

The most important of these muscles is the genio-glossus. From its fibres proceeding in every direction, those going to the point of the tongue pull it backwards, the fibres going backwards draw it forward, and those in the middle make it hollow on the back, while the tip and root of course naturally rise.

The hyo-glossus, composing the side of the tongue, pulls it downwards and rounds its back; and

The stylo-glossus, from forming the inside of tongue, draws it deep into the mouth, and particularly influences its point.

## CCCXLI.

After this general description of the muscles of the jaws, throat, and tongue, it is useful to consider their mode of action in one united view; 1<sup>st</sup>, in taking food, and 2<sup>dly</sup>, in employing the voice.

In opening the mouth to receive the food, all the muscles are employed that raise or depress either of the lips. The mouth is then shut by the

orbicularis muscle, and the flesh of the lips and cheeks pressed close by the masseter and buccinator, for we scarcely assist much by the elevators of the lips, which rather tend to separate the lips from the gums. In the mean time, by the motion of the jaws, the food is manducated. The masseter, temporal, and pterygoideus muscles, are fitted for raising the jaw upwards, and that with different degrees of obliquity, as they act on both sides more or less in concert; but it is chiefly the external pterygoideus which affects the lateral motions, moving the jaws alternately to the two sides; or, it is used to bring the lower jaw forwards beyond the upper jaw, while it commonly falls within it.

## CCCXLII.

While the food is manducated, it is confined by the motion of the tongue from being thrown inwards, and this organ is capable of more varied motions than could be expected from viewing the muscles that are inserted into it. It depends upon the circumstance that has been shewn, the fibres of these muscles being continued into the substance of the tongue; and it is probable that the terminations of these fibres act in a very different way from their origins, so that the muscles serving to move the whole body of the tongue, may serve the purpose of a great variety. The *musculus lingualis*, in particular, seems to have

this varied action, just as the sphincters of the bladder has its action, different from that of the very fibres that form it.

## CCCXLIII.

When the food is sufficiently manducated by the tongue, it is gathered up and carried backwards into the throat, which is chiefly done by the two stylo-glossi muscles that pull the tongue backwards into the throat; while, at the same time, the tip of the tongue is raised to the roof of the mouth by the rest of the muscles. By bringing the tongue backwards with the food upon it, the muscles connecting the tongue to the epiglottis are now relaxed, which comes to be pressed down upon the glottis, and thus respiration comes to be stopped, and life being in danger, a sudden effort of nature succeeds to relieve us, The several muscles are now thrown into a convulsive action, particularly the digastric, by means of which an effort of swallowing is made, as well as by means of the others beneath it, which are all put into sudden exertion, and at the same time. Thus the omo-hyoideus, the genio-hyoideus, and thyro-hyoideus act, that the larynx may be pulled forwards along with the os hyoides; in consequence of which the pharynx is dilated, and room is made for the food which is now thrown with violence over the epiglottis; or rather, the epiglottis and pharynx are drawn forwards so as to leave the food

in the pharynx, and from the larynx being the forepart of the pharynx, it is mechanically dilated. In the time of this exertion, the nostrils are shut in the most accurate manner.

## CCCXLIV.

The food being now thrown with a considerable jirk into the pharynx, it is immediately irritated to perform its exertions, and the fibres in a circular oblique manner begin their contractions from an instinct of nature, which determines the motion downwards, and by the constrictors of the pharynx the food is pushed into the œsophagus: but, as soon as it has descended a certain way, the digastric and other muscles are relaxed, there being now no danger of the food ascending again; and by the successive action of the muscular fibres of the œsophagus, it is thrown down into the stomach. That the pharynx is contracted in the most accurate manner, and that this contraction follows the food close, appears from the accuracy with which fluids are swallowed, and air it is found can be swallowed with equal ease.

## CCCXLV.

The formation of the voice, the next function of these parts, is made, as formerly noticed, by means of the ligaments of the larynx, and the voice is shaped into letters as the sound passes through the mouth. But in investigating this

subject, we observe the great question to be determined is, whether the voice is to be compared to a wind, to a corded instrument, or to both? The tones of wind instruments depend alone on the size and situation of their apertures, and the current of air through these, independent of the materials of which they consist. The corded instruments again depend not only on the vibration of the cords, but also on the materials of which the instrument is formed. That the ligaments resembling a corded instrument have much effect, is proved by cutting away the points of the arytenoid cartilages in a dead animal, when by blowing through the lungs, and giving a proper tension to the ligaments, the voice of the animal can be imitated. But that the state of the aperture of the glottis is also essential, seems equally clear, from the muscles being equally fitted for this purpose as for affecting the ligaments, and from considering also the manner employed when an acute or gross note is intended to be sounded. To do this, not the ligaments alone are employed, but by an instinct of nature an inspiration is made, <sup>since</sup> the diaphragm is depressed, the weight of air passes down the lungs, and stretches the trachea in all its branches, while the thyroid cartilage is likewise drawn strongly upwards, and stretched to the full. Thus also it may be observed in whistling, that the notes depend upon the aperture as

well as upon the tension of the sides of the lips, which is proved in birds; where, if a hole is made in the trachea higher up, not only the strength but tone of the voice is altered. Thus the larynx possesses the advantage not only of a wind but of a corded instrument, so far, that it unites them together; and instead of being acted upon by solid bodies as a corded instrument, it is acted upon in a much nicer way by the air thrown out of the lungs.

## CCCXLVI.

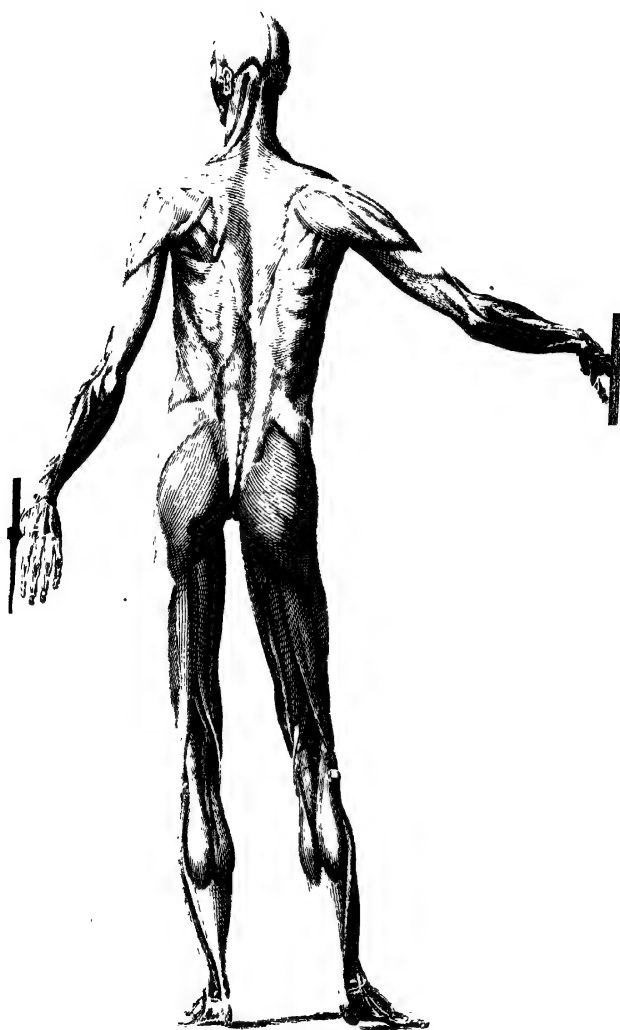
*Muscles of the Arm.*

Varying somewhat in the plan of our arrangement from the demonstration of the bones, we next proceed to the muscles of the upper extremities; and thus we begin with the motions of the scapula.

## CCCXLVII.

*Muscles of the Scapula.*

The peculiar connection of the scapula to the trunk was formerly observed, loose as it were, and yet connected and depending entirely on its muscles for this junction. By the upper extremity being separated into so many divisions, the power of its motions and their variety is increased. Thus the scapula is the centre of its motions, and its action is therefore unconfined. The arm again requires only an easy circular motion, and by the number of its joints this circular motion is complete; for







by the shoulder joint the arm is rolled, the division of the elbow limits this, and acts like a hinge, while the wrist turns round, obedient to the motions of the other two.

## CCCXLVIII.

The muscles of the scapula arise from four different points correspondent to their different motions. To move it forwards, their origin is the breast. To move it backwards, they proceed from the vertebral spines. To move it upwards, their fixed point is the neck; and to move it downwards, they arise from the ribs.

## CCCXLIX.

The first of them we enumerate is the trapezius, an extensive occipital muscle, which, with its fellow, covers all the shoulders and neck in a lozenge-like form. It is situated immediately under the teguments of the posterior part of the neck and back. It extends from the tip of one shoulder to the tip of the other, and from the nape of the neck quite down to the loins. Its origin is by a thick, round, and short tendon from the middle of the great arched ridge of the occipital bone, and from the transverse spine quite down to the mastoid process, from its fellow over the spinous processes of the cervical vertebræ by the intervention of that part of its tendon called ligamentum nuchæ or colli, from the spinous processes

of the two inferior vertebræ of the neck; and from all those of the back, adhering tendinous to its fellow the whole length of its origin.

After this extensive origin it becomes inserted fleshy into the broad posterior half of the clavicle, tendinous and fleshy into one half of the acromion, and into almost all the spine of the scapula.

From this various situation of its fibres in their action, they must have various or different effects. Thus its upper descending fibres pull the scapula obliquely upwards. Its middle transverse ones draw it directly backwards. Its inferior fibres, which ascend obliquely upwards, pull it obliquely downwards and backwards; and, when the whole of them come into action in succession, the scapula will be rolled. Hence, also, the trapezius is a muscle of the neck and head, as well as of the scapula, the upper part of it drawing the head backwards, and turning it on its axis.

### CCCL.

#### *Levator Scapulae.*

This long muscle is situated obliquely under the anterior edge of the trapezius and arises, by four, sometimes five, distinct heads, from the four or five uppermost vertebræ of the neck uniting to form it about three inches broad. It is inserted by a flat thin tendon into the upper corner of the scapula; and its action is to shrug the shoulders

or raise the scapula upwards and a little forwards. It has been termed also *musculus patientiæ*.

## CCCL.

*Rhomboides.*

The rhomboid muscle is stretched between the spine and the base of the scapula in a neat square form. It arises from the spinous processes of the four superior vertebrae of the back, from the three inferior of the neck, and from the ligamentum nuchæ; and, descending obliquely, it is inserted into the whole length of the base of the scapula. It is sometimes divided into two muscles, the upper part being termed the *rhomboides major*, and the under part the *rhomboides minor*. Both are seen on raising the trapezius. The uses of this muscle are to draw the scapula obliquely upwards, and directly backwards.

Thus, by the three muscles described, is the scapula raised and drawn back; while, by the two next lying on the breast, it is moved down and drawn forwards.

## CCCLII.

*Serratus Major Anticus.*

This muscle lying on the side of the chest, arises from the ribs, and from the different interstices placed between the ribs; hence it must arise by distinct portions, or be serrated. The chief part of this muscle lies under the scapula, and is the cushion

in part on which it glides; and its origins are the parts of it chiefly conspicuous, which are from the nine first ribs, so that it covers the whole side of the thorax. It is inserted into the whole line that forms the base of the scapula, being folded round its angles. Its action is to move the scapula forwards or downwards, according to the direction of its different digitations; and when the scapula is forcibly raised to assist in dilating the thorax by raising the ribs. It is chiefly by the contraction of this muscle that the shoulder is supported when loaded with any heavy weight.

## CCCLIII.

*Pectoralis Minor.*

This muscle is situated at the anterior and lateral part of the chest, arising from the edges of the 3<sup>d</sup>, 4<sup>th</sup>, and 5<sup>th</sup> ribs, in a serrated form. Its three serrated points soon unite into a thick fleshy muscle, which is inserted by a narrow slip or tendon into the upper part of the coracoid process of the scapula. Its principal use, by pulling the coracoid process, is to bring the scapula downwards and forwards; and when that is fixed, perhaps, to raise also the ribs.

## CCCLIV.

*Subclavius.*

The subclavius is another muscle hid by the scapula. It is situated between the clavicle and

first rib, arising tendinous from the cartilage of the latter, and being inserted into the under surface of the clavicle for nearly its whole length. Its action, therefore, is to pull the clavicle, and with it the scapula, downwards and forwards.

## CCCLV.

By the description, then, of these muscles, the motions of the scapula will be understood. By the levator and trapezius, it is evidently directed upwards; by the rhomboides, assisted in part by the trapezius, it is moved backwards. By the under part of the same trapezius, it is drawn both backwards and downwards. By the serratus major, it is pulled also downwards and forwards. By the serratus, along with the trapezius and subclavius, it is brought directly down, and by the pectoralis minor it is carried directly up. From these motions of the scapula, we proceed to the arm.

## CCCLVI.

*Pectoralis Major.*

This broad, thick, radiated muscle, covers almost the whole anterior part of the breast. It arises tendinous from two-thirds of the clavicle next the sternum, from the whole sternal edge, and fleshy from the cartilaginous extremities of the fifth and sixth ribs. It is intermixed in its course with the external abdominal muscle, and is inserted above the insertion of the deltoid muscle

by a broad tendon into the os humeri. The upper or clavicular part of this muscle is often separated by a fatty line from the under or thoracic, so that they have been named as two distinct muscles. The use of this muscle is to draw the arm forwards towards the sternum, and to assist occasionally to move the trunk upon the arms, as when an exertion is made with the hand.

## CCCLVII.

*Latissimus Dorsi.*

All the lower part of the back and loins receive a covering from this muscle, the broadest in the body. It arises by a broad tendinous expansion from the back part of the spine of the os ilium, from all the spinous processes of the vertebræ, extending between the bottom of the os sacrum and sixth vertebra of the back, and by three or four tendinous slips from the same number of inferior ribs. From these different origins the fibres of the muscle advance in different directions; the lower ones ascend, the upper ones go directly across; and these different orders not only meet, but cross each other, like those of the pectoral muscle. It is inserted by a long, flat, thin tendon into the posterior edge of the groove between the two tuberosities of the os humeri, where the tendon of the long head of the biceps is lodged; and where it is joined also by the tendon of the pectoralis. By the action of this muscle, the

arm is pulled downwards and backwards, and the os humeri is rolled inwards, by which the palm of the hand is made to fall backwards. When joined in action by the large pectoral muscle, the arm is drawn down towards the trunk. It is by the union of these two muscles, that the axilla also, or armpit, is formed; where they serve as a protection to the vessels and nerves in that situation, the action of both is powerful, both from their own strength as muscles, and also from the manner of their insertion. The office of the one, the pectoral, is to draw the arm forwards, while the other brings it down, when once raised, with much force, or rolls it inwards and backwards. By their joint operation the arm is pulled directly down, and by this means, on certain occasions, the body may be raised.

## CCCLVIII.

*Deltoides.*

This muscle, so named from the Greek letter  $\Delta$ , covers the anterior part of the joint of the os humeri, filling up the space between the acromion and shoulder bone. It arises in three divisions: 1<sup>st</sup>, From all that part of the clavicle not occupied by the pectoral muscle: 2<sup>d</sup>, From the point of the acromion process: And, 3<sup>dly</sup>, From the spine of the scapula behind it. Thus it possesses three heads, or origins, from each of which it runs in different directions, separated from each other by



slight fissures, and forming as it were three distinct muscles; for the fibres from the scapula run forwards, from the acromion downwards, and from the clavicle outwards. These divisions all meet about the middle of the humerus, in a short flat strong tendon, which nearly surrounds the shoulder bone. The principal use of the deltoid muscle is to draw the arm directly upwards; and when the arm is raised, it will be moved a little forwards or backwards, according to the different directions of the anterior and posterior portions of the muscle. The different bundles of fibres, therefore, of this muscle, in order to produce their full effect, must fall to act in succession.

## CCCLIX.

*Coraco Brachialis.*

This is a long slender muscle, covered by the deltoid and pectoral muscles. It arises tendinous and fleshy from the forepart of the coracoid process of the scapula, in common with the short head of the biceps to which it adheres, and is inserted into the middle of the internal part of the os humeri. From its beginning, which is small, it gradually grows thicker as it descends, and is perforated at its lower part by the muscular-cutaneous nerve. In its action, this muscle is intended to give a degree of rotation, by bringing the arm obliquely upwards and forwards. It likewise assists in pulling the arm to the side.

## CCCLX.

*Supra Spinatus.*

This muscle is of considerable thickness, and occupies the hollow of the scapula above the spine. Its origin is from the base of the scapula, from the spine, and from the superior costa. It is inserted tendinous into the large tubercle on the head of the os humeri. Its use is to raise the arm directly upwards, and at the same time, from its attachment to the capsular ligament, to pull it from between the bones, so that it may not be caught or pinched by the joint. It may also serve to move the scapula upon the humerus.

## CCCLXI.

*Infra Spinatus.*

The triangular cavity below the spine, is the seat of this triangular muscle, which is considerably covered by the deltoid. It is thick and strong, and covered by a strong tendinous expansion. It arises fleshy chiefly from all that part of the base of the scapula, that is between the spine and its lower angle, and it is inserted into the upper posterior part of the large protuberance on the head of the os humeri. By its action, this muscle serves to turn the os humeri outwards upon its axis, to assist in raising and supporting it when raised, and to pull, like the former muscle, the ligament from between the bones. Perhaps, in conjunction with the former, to pre-

vent also the humerus, when the arm is much bent backwards, from starting from its socket.

## CCCLXII.

*Teres Minor.*

This muscle, so named from its appearance, is a long small fleshy one. It is situated along the inferior part of the infra spinatus, and partly covered also by the deltoid. It arises from the angle and lower edge of the scapula, and it is inserted tendinous into the back part of the large protuberance on the head of the os humeri, a little below the former muscle. Its uses are the same with the infra spinatus.

## CCCLXIII.

*Teres Major*

In its shape resembles the former, but is longer and thicker, and lies lower upon the edge of the scapula, being situated at the under part of the teres minor, and sending off a broad flat tendon, which accompanies the latissimus dorsi; and which, with the tendon of this list, is included in one common scapula, or sheath. Its use is to assist in the rotatory motion of the arm, and to draw it down and backwards, as an assistant to the latissimus dorsi.

## CCCLXIV.

*Subscapularis.*

This muscle lines all the cavity of the scapula like a cushion, being the shape of the surface of

the scapula, on which it lies. It is therefore triangular, strong, and fleshy. It arises from the three costæ, and inner surface of the scapula, adhering to all the risings and depressions of this bone. It is inserted tendinous into all the upper part of the internal protuberance at the head of the os humeri, and it goes round the head of the os humeri to its insertion. By the action of this muscle, the arm is rolled inwards, or drawn to the side of the body; and from its attachment to the capsular ligament, it conduces also to prevent the latter being pinched.

## CCCLXV.

From this view of the muscles of the arm, their particular effects will be apparent.

The insertion of them at the head of the os humeri, naturally occasions their drawing the arm upwards; and this motion we find the supra spinatus, the infra spinatus, and teres minor, to have. The same insertion belongs to the deltoid, somewhat lower, which will of course increase its power.

The scapularis being inserted opposite to the former, must possess an opposite effect, and draw the arm downwards and backwards; while the pectoralis and coraco brachialis being implanted into the outer edge of the bicipital groove, their action will pull the arm to the side, and somewhat upwards. The arm we have seen pulled directly backwards by the latissimus dorsi

and teres major, from their insertion by the lower side of the groove, and as they pass under the arm to meet this point, the palm will be rolled by them inwards and backwards. As these several muscles successively act, the different rotatory motions of the arm will be performed.

## CCCLXVI.

Nor must it be omitted, the share these muscles have, from their insertion, in giving strength and firmness to the loose texture of the joint. Hence, as it requires, in order to possess a quick and varied motion, a loose connection of its ligament and other parts, it is surrounded by the heads of strong muscles to prevent any injury which, in its exertions, the weakness of its texture might expose it to. By attending to the insertions of the different muscles, this circumstance will be apparent.

## CCCLXVII.

*Muscles of the Forearm.*

The motions of the forearm are flexion and extension; and to perform these, four muscles are appropriated.

## CCLXVIII.

*Biceps Brachii Flexor.*

The first of these arises by two heads, from which it derives its name. It is a thick, strong muscle, feeling like a hard ball when in action. Its outer or long head begins by a slender tendon

from the upper edge of the glenoid cavity of the scapula. Its inner head, or short one, arises tendinous and fleshy from the coracoid process of the scapula. A little below the middle of the forepart of the os humeri, these two heads unite, and form a thick fleshy belly. The insertion of this muscle is into the tubercle of the radius, at its upper and inner part, and the tendinous expansion on the aponeurosis of the forearm, is formed by it in its progress. The principal use of this muscle is to bend the forearm, and likewise to assist in rolling the radius upon the ulna from within, outwards, as in the motion of supination, or turning the palm upwards. From its origin it will also move the humerus, as well as the forearm.

## CCCLXIX.

*Brachialis Internus.*

This muscle, of an oblong shape, and considerable thickness and breadth, is situated immediately under the biceps. It is an assistant to the latter. It arises from two-thirds of the os humeri at its fore part, and comes down from each side of the deltoid, its head being forked. By a strong flat tendon it is implanted into the coracoid process of the ulna. The chief action of this muscle is to bend the forearm, and to prevent the ligament of the joint from being pinched, though its connexion is rather slight for this purpose.

## CCCLXX.

*Triceps Extensor.*

All the posterior part of the os humeri is occupied by this muscle, which arises with three heads, and has been described as three separate muscles. The first middle or long head, springs broad and tendinous from the inferior costa of the scapula, near its neck. The second begins from the arm-bone below the great tuber; and the third, or shortest, arises from the back part of the os humeri, near the insertion of the teres major. The three heads unite about the middle of the humerus, and cover the whole posterior part of the bone adhering to it in their descent, and forming one thick muscle, which is inserted into the upper and outer part of the olecranon of the ulna, and partly into the condyles of the os humeri, adhering firmly to the ligament. The simple action of this muscle is to extend the forearm, or hinge-joint of the elbow, with great power.

## CCCLXXI.

*Anconæus.*

The last muscle of this part is the anconæus, a small triangular one, placed on the back part of the elbow. Its origin is tendinous from the posterior part of the condyle of the os humeri, and it is inserted by oblique fleshy fibres into the back part or edge of the ulna. The tendon of this muscle

adheres strongly to the triceps, and its action is to assist the triceps in extending the forearm.

## CCCLXXII.

Before leaving these muscles, it is to be observed, that the aponeurotic expansion, or condensed cellular covering, forms also a source of attachment for them, although a secondary one, as well as the bones; and for this purpose it both dives between their fibres, as well as forms partitions or divisions in their structure. Thus we find one tendinous expansion descends from the neck, which receives an addition by the tendon of the deltoid muscle. In its farther descent, it covers all the arm, and receives at the forearm a farther addition from the biceps and triceps extensor. In its descent, also, it gives off partitions among the muscles, and these are fixed to the radius and ulna, the membrane itself being lost insensibly upon the hand. It is thicker and stronger on the outside than the inside of the extremity, particularly on the forearm, at the under and back part of which it forms a thick and strong tendon. By these expansions a firm hold is given to the muscles, their places preserved, and an attachment given to many of their fibres.

## CCCLXXIII.

*Muscles of the lower Part of the Arm and Hand.*

The use of these muscles is to bend the wrist and fingers, and to roll the hand.



The wrist is bent and extended by its flexors and extensors.

The fingers are regulated in their motions by muscles of a similar use. And,

The hand is rolled, or its motions of supination and pronation made by its pronators and supinators, which motions consist in turning the hand down, which makes its pronation, or reversing this, and turning it upwards, which makes its supination.

#### CCCLXXIV.

The muscles of these parts are chiefly named from their uses. Their situations of origin and insertion, as well as their uses, are easily understood as they all spring from two points, and their uses are confined, as noticed, to two kinds of motion.

The points of origin are the internal and external condyles. The former being the longest, gives most power. Hence, the muscles of greatest action and importance arise from this part, or the pronators and flexors. The latter is the shortest, and therefore gives less force of action to the muscles; hence it is the origin of the supinators and extensors.

#### CCCLXXV.

The muscles arising from the internal condyle, first claim attention.

*Pronator Teres Radii.*

The first, or pronator teres radii, is a small round muscle, so named from its office. It arises fleshy from the internal condyle of the humerus and the coronoid process of the ulna; and between these two passes the radial nerve. From these origins it runs obliquely downwards and outwards, and is inserted tendinous into the middle of the posterior part of the radius. By the action of this muscle the hand is turned downwards by turning the radius inwards, or placed in a state of pronation. It will also have some influence in bending the forearm in strong action.

## CCCLXXVI.

*Palmaris Longus.*

Immediately under the teguments is the situation of this long thin muscle, which arises tendinous from the internal condyle of the os humeri, and also from the inter-muscular tendon; and after passing down about three inches, it terminates in a long slender tendon, which near the wrist separates into two portions, one of which is inserted into the internal angular ligament, and the other loses itself in a tendinous membrane, but is nearly of a triangular shape, and extends over the palm of the hand from the carpal ligament to the roots of the fingers, and is called the ~~palmar~~ aponeurosis, under which all the muscles and vessels of the hand run. After its expansion

on the palm of the hand, this is fixed to the roots of all the fingers by an equal number of double slips. This muscle is frequently wanting, but the aponeurosis is always to be found. Its action is to bend the hand, and particularly to stretch the aponeurosis. It may also assist in its pronation.

### CCCLXXVII.

#### *Palmaris Brevis.*

This muscle arises by small bundles of fleshy fibres from the palmar aponeurosis, near the annular ligament. It stretches across the hand, and is inserted into the metacarpal bone on which the last finger stands, and into the skin and fat which covers the edge of the palm. By its action it assists in contracting the palm of the hand.

### CCCLXXVIII.

#### *Flexor Carpi Radialis.*

This is a long thin muscle, situated obliquely at the inner and anterior part of the forearm. It arises from the inner condyle, stretching along the middle of the forearm, and it terminates in a long flat tendon which runs into the annular ligament in a groove peculiar to itself; and afterwards expanding a little it is inserted into the metacarpal bone of the forefinger, touching that one which supports the thumb. By its action it bends the wrist, and assists in the pronation of the hand.

## CCCLXXIX.

*Flexor Carpi Ulnaris*

Is a long muscle that arises tendinous from the inner condyle of the os humeri, and by a small fleshy beginning from the inner side of the olecranon. Its course is along the under edge of the forearm. Between its heads, the ulnar nerve perforates this muscle. It receives various attachments in the course of its progress, and is at last inserted into the os pisiforme at its forepart, where it sends off a thin tendinous expansion to cover the annular ligament, and a similar one to cover the muscles of the little finger. The action of this muscle is to assist the former in bending the wrist, to serve as a balance to it; and, by the action of this one alone, the edge of the hand is pulled sideways.

## CCCLXXX.

*Flexor Digitorum Sublimis.*

This is a long muscle situated at the anterior and inner part of the forearm. It is termed sublimis from its situation, being the most superficial of two muscles, and perforatus, from being perforated by the tendon of the muscle below. Both its belly and tendons are divided into four fasciculi, corresponding to the different fingers it is to serve. It arises from the inner condyle of the os humeri, from the ligament of the elbow joint, from the coronoid process of the ulna, and

from the upper and fore part of the radius, down to near the insertion of the pronator teres. It is inserted into the anterior and upper part of the second phalanx of the fingers, being split and twisted to form a passage near the under part of the first phalanx. The use of this muscle is to bend the second joint of the fingers, besides which, it must also move the hand upon the wrist, and even the forearm upon the arm from the number of joints it passes over, and the connections it consequently forms.

## CCCLXXXI.

*Flexor Digitorum Profundus*

Corresponds in its situation and offices nearly with the former. It lies deeper, and arises fleshy from the external side and upper part of the ulna for some way downwards, and from a large share of the interosseous ligament. About the middle way, downwards, it divides into four portions or tendons, to answer the four fingers. These run through the flits of the former muscle, and are inserted into the anterior and upper part of the last bone of each finger. The office of this muscle is to bend the last joint of the finger, and in its course, to perform the same actions as the former muscle.

## CCCLXXXII.

*Lumbricales.*

As an appendage to the last muscle, fall to be

demonstrated the lumbricales, which arise from the outside of its tendons, a little above the lower edge of the annular ligament of the wrist. They are four small round muscles, in form and size resembling the earth-worm, and therefore so named. They are of different sizes, and send off long slender tendons at the under ends of the metacarpal bones, which are implanted into the outer sides of the broad tendons of the interosseous muscles, about the middle of the first phalanx, about the bone of which they gradually wind. By their action, the first joint of the fingers is bent, and the second also extended, so that they increase the flexion of the fingers, while the long flexors are in full action. Their power is chiefly conspicuous in short quick motions, as in playing on the fiddle.

## CCCLXXXIII.

*Flexor Longus Pollicis.*

This muscle runs along the inner side of the radius. It begins by an acute fleshy origin from the fore part of the radius downwards, and interosseous ligament, till it reach the pronator quadratus muscle; and beyond this, it even passes to the entry under the ligament of the wrist. Besides this origin, it frequently has another from the internal condyle of the os humeri. It is inserted into the last joint of the thumb, after passing its tendon under the anterior annular ligament of

## ccxxxviii DEMONSTRATION

the wrist. Its use is to bend the last joint of the thumb, and to assist in bending the other joints it passes over like the former flexors.

### CCCLXXXIV.

#### *Pronator Quadratus.*

The name of this muscle is derived from its use and shape. It arises tendinous and fleshy from the lower and inner part of the ulna, and runs nearly in a transverse direction to be inserted into that part of the radius which is opposite to its origin. Its use is to turn the radius upon the ulna, and then to assist the pronator teres in the pronation of the hand.

### CCCLXXXV.

This finishes the muscles arising from the internal condyle of the humerus, those that take their rise from the external condyle, or the extensors, come next into review.

### CCCLXXXVI.

#### *Supinator Radii Longus.*

The first is the supinator radii longus, which forms the very edge of the forearm. It arises by many short fibres from the ridge of the os humeri, above the external condyle, nearly as high as the middle of the bone. It forms a thick fleshy belly as it passes the elbow joint, and there gives a peculiar form to the arm. It then becomes small, and forms a tendon along the edge of the radius,

which is inserted into the outer side of its under end. In its action this muscle rolls the radius outwards, and of course turns the hand into a supine situation, with the palm forwards. It is also, in some degree from its origin, a flexor of the forearm.

## CCCLXXXVII.

*Extensor Carpi Radialis Longior.*

This muscle is almost entirely covered by the last, and is named longior, to distinguish it from it. It arises from the ridge of the humerus above the external condyle, and just under the origin of the former. Its course is along the back of the radius, where it is thick and fleshy till it reaches its middle, when it sends off a thin flat tendon. This passes down first upon the outer, and then upon the back part of the radius, descending there in a groove, and going under the annular ligament of the wrist. It is inserted into the upper, back, and outer part of the metacarpal bone of the forefinger. Its principal use is to extend the wrist, and bring the hand backwards.

## CCCLXXXVIII.

*Extensor Carpi Radialis Brevior.*

This muscle agrees entirely with the former in its description and uses. It arises from the external condyle of the os humeri, and from the ligament which connects the radius to it. Its



tendon passing down the back part of the radius, goes under the annular ligament in the same groove with the tendon of the former muscle. It is inserted into the forepart of the tendon of the middle finger, a little towards that edge next the radius. Its uses are to assist the former muscle in extending the wrist, and to draw the hand, with the assistance of the flexor carpi radialis, to the side next the thumb.

## CCCLXXXIX.

*Extensor Carpi Ulnaris.*

This muscle arises tendinous from the external tubercle of the os humeri, and lies along the ulnar edge of the arm. It becomes tendinous in the middle of its length, and its tendon is inclosed by a membranous sheath in a groove at the back part of the ulna. It is fixed into the outside of the lower head of the metacarpal bone of the little finger. By its action it assists the two former muscles in extending the wrist, or, with the assistance of the flexor ulnaris, it draws the hand towards the side, next the little finger.

## CCCXC.

*Extensor Digitorum Communis.*

This muscle covers the middle of the forearm at its back, and lies between the extensor radialis secundus and the extensor minimi ~~digiti~~. It arises from the outer condyle of the os humeri,

and from the inter-muscular membrane. It grows fleshy and thick as it descends; and about the middle of the forearm divides into three or four tendinous slips. These form so many roundish tendons, which are included in a thin membrane, and pass altogether under the ligament to the convex surface of the carpus, when they separate from each other, and become flatter and more expanded. About the extremities of the metacarpal bones they send off tendinous filaments to each other, and they are at length inserted by a tendinous expansion into the back part of all the fingers. The use of this muscle is to extend the fingers.

## CCCXCI.

*Extensor Minimi Digiti.*

This long thin muscle is situated immediately under the common teguments, and is often described as a slip of the last muscle. Its origin is from the outer condyle. It passes down, gradually, increasing in size; and its fleshy fibres disappear when it reaches the external annular ligament, under which it passes in an oblique direction, and in a channel peculiar to itself. When this tendon reaches the metacarpal bone of the little finger, it sends off filaments which unite with the tendon of the extensor communis, and the rest of it is inserted into the phalanges of the little finger; which, from its name, it serves to extend, as also the others by its communicating band.

## CCCXCII.

*Extensor Primus Pollicis.*

This muscle, termed also abductor longus, lies just under the fore edge of the radius, arising with it, and crossing it obliquely. It divides into three or four fleshy slips, which pass under the external ligament of the carpus, and are fixed into the roots of the first phalanx of the thumb towards the radial edge. Hence the use of this muscle is to extend the thumb, and to incline it a little outwards towards the radius, or to draw it from the fingers. Other motions it may also assist in.

## CCCXCIII.

*Extensor Secundus, or Minor Pollicis*

Lies close by the former, arising from the same edge of the radius, and it runs along with it in the same bending course. Its small round tendon passes sometimes in a peculiar channel. It goes over the metacarpal bone of the thumb, expands upon its first phalanx, and is inserted just under the second joint. The second base of the thumb is extended by it upon the first; and it assists also in extending the wrist.

## CCCXCIV.

*Extensor Tertius Pollicis.*

This muscle corresponds with the two former. Its origin is from the ridge of the ulna, and its course is longer than the others. It is penniform in its descent to the ligament of the wrist, and

its tendon goes through in a peculiar ring. This tendon splitting, passes along the ulnar side of the first phalanx of the thumb, and reaching the second, is implanted in it; from which, expanding, it proceeds to its insertion at the root of the third phalanx. By the action of this muscle, the different joints of the thumb are moved, particularly the last; and this motion extends also to the different parts it passes over, or to the metacarpal bone upon the carpus, and to the carpus itself.

## CCCXCV.

*Indicator.*

The origin and course of this muscle is much the same as the last. It has an acute fleshy beginning from the middle of the posterior part of the ulna, at the inner side of the extensor secundus. It is attached somewhat to the interosseous membrane. Its tendon passes under the external annular ligament of the wrist, along with those of the extensor communis digitorum, and from thence running along the convex surface of the hand, is united at the lower end of the metacarpal bone of the forefinger with the tendon of the extensor communis that goes to that finger, into the posterior part of which they are both inserted. By its action, all the joints of the forefinger are extended, and the common extensor is assisted by it in pointing that finger, independent of its effect on the joints over which it passes.

## CCCXCVI.

*Supinator Brevis.*

This small muscle, situated at the upper part of the forearm, lies concealed under the supinator longus. Its origin is tendinous from the external condyle of the os humeri, from the outer and upper part of the ulna, and from the interosseous ligament. It passes over the external part of the radius, and is inserted into its ridge. By its office, it is limited to that of rolling the radius outward, and thus assisting in the supination of the hand.

## CCCXCVII.

*Muscles in the Hand.*

To assist the larger muscles described, a farther provision is made by a collection of small ones seated in the hand itself. These, from their quick action, obey every small motion, and particularly assist the lateral motions of the thumb, and also of the little finger.

All the muscles of the thumb, form the great ball on its inside, and their different actions, are regulated by the different places of their insertion.

## CCCXCVIII.

*Abductor Pollicis.*

The first is the abductor pollicis, covered only by the teguments arising from the whole length of the metacarpal bone of the middle finger.

It passes across the metacarpal bone of the forefinger when its fibres converge, and send off a short tendon to be implanted into the inner part of the root of the first bone of the thumb. Its office is to draw the thumb from the fingers, and to extend the second bone upon the first.

There is frequently another muscle of the same name, holding the same course, and performing the same office.

## CCCXCIX.

*Opponens Pollicis.*

This muscle, named also the metacarpal of the thumb, is implanted into the side of the thumb. It arises from the os scaphoides and the ligament of the wrist, and it is inserted into the under and fore part of the metacarpal bone of the thumb. Its use is to turn the first bone of the thumb upon its axis, and at the same time to bring it inwards, opposite to the other fingers, as in clinching the fist.

## CCCC.

*Flexor Brevis Pollicis.*

This two headed muscle, situated betwixt the forefinger and thumb, extends obliquely across the two first metacarpal bones. It arises from the os trapezoides, magnum and unciforme, and it is inserted into the first and second sesamoid bone, and base of the first bone of the thumb. The use of this muscle is to bend the first joint of the fingers

upon the second, and to move also the other joints it passes over.

## CCCCI.

*Adductor Pollicis.*

This muscle arises from the metacarpal bone of the middle finger, and goes directly across the metacarpal bone of the forefinger to meet the thumb. In its shape it is triangular and flat, having its base at the metacarpal bone, and its point at the thumb. It is inserted into the inner part of the root of the first bone of the thumb. Its particular use is to pull the thumb towards the forefinger.

## CCCCII.

From the thumb being the opponent of the fingers, it is surrounded with muscles which form its large upper ball of flesh. By these muscles it is bent and affixed to the hand; and in the same manner the muscles of the little finger also surround it.

## CCCCIII.

*Abductor Minimi Digiti.*

This is a thin fleshy muscle which helps to form the prominence at the inner edge of the palm of the hand. It arises fleshy from the inner surface and inferior edge of the os pisiforme, and from the adjacent part of the internal annular ligament, and it is inserted by a flat tendon into the first bone of the little finger laterally. Its

use is to draw the little finger from the rest by spreading it sideways, and to assist also in some degree the flexors.

## CCCCIV.

*Flexor Parvus Minimi Digiti.*

By the side of the last rises this small thin muscle with the same course and insertion. Its origin is the hook-like process of the os unciniforme, and from that part of the anterior annular ligament of the wrist next it. It is inserted by a roundish tendon into the inner part of the base of the first bone of the finger. Its use is to bend the little finger, and assist the former muscle.

## CCCCV.

*Adductor Minimi Digiti.*

This muscle lies immediately under the former one, and is sometimes named the metacarpal of the little finger. It arises from the same origin as the former, and is inserted into the outside of the metacarpal bone, which it reaches by turning round it. Its use is to bend the metacarpal bone, and bring this finger towards the rest, so as to make it an antagonist to the others, and it resembles in this respect the opponens pollicis. By its action, also, the external convexity of the carpus is increased, and thus *Diogenes's* cup is formed.



## CCCCVI.

*Abductor Indicis.*

This muscle arises from the os trapezium, and from the first bone of the thumb. It is inserted into the back part of the first bone of the finger. It is a muscle of considerable breadth, and its action is to pull the forefinger towards the thumb.

## CCCCVII.

*Interosseous Muscles.*

The interosseous muscles follow next in order, situated betwixt the metacarpal bones, to the sides of which they are also attached; and by their action they bend the first, and extend the second joint of each finger. They are divided into the external and internal; and though something larger, they resemble the lumbricales.

## CCCCVIII.


*External.*

The external are situated directly on the back of the hand; they are four in number. They arise with double heads, and send their tendons twisting round the sides to the backs of the metacarpal bones, where they are inserted along with those of the lumbricales, and the extensors of the back of the fingers.

## CCCCIX.

*Internal.*

The internal are situated in the palm of the

hand, and are three in number. Their origin is the same as the former, from the metacarpal bones and their interstices, and also from the ligaments of the carpal bones. They are distinguished by having two heads, and their tendons are joined to those of the extensor and lumbricales. Their particular enumeration is unnecessary. They possess one common office of extending the fingers, and the tendons of the flexors join their tendons, so  to meet on the back of the fingers, which part is in consequence covered by a strong united band of tendinous fibres.

## CCCCX.

After this full enumeration of the different parts that conduce to the motion of the upper extremity, it will be proper to consider the co-operation of the muscles in review. Thus, when we mean to raise the scapula, the muscles are employed that decussate each other, the obliquity of the one balancing the obliquity of the other, viz. the upper part of the trapezius and the levator scapulæ. If we intend to pull it down to press any thing under the arm, the lower part of the trapezius is employed; for different parts of a muscle may be employed at different times, and with it, at the forepart, the serratus major anticus, particularly the portion of it near to the lower angle, which moves it farther than a straight

muscle could have done. If we intend to bring it backwards, the whole of the trapezius is employed, but more especially the upper and lower ends of it: but the rhomboides can be also employed. To make it advance forwards, the lesser pectoral and lesser serratus are put in action: but the large serratus has a greater effect, drawing the whole scapula forwards. If a rotation again of the scapula is meant, the centre of its motion is the clavicle. First, then, it turns upon the end of the clavicle: but to increase the rotation, the clavicle is rolled also; and for this rolling of the scapula, the muscles are employed that are inserted obliquely, and one of them only is put in action at a time.

## CCCCXI.

The different muscles again that act on the humerus are nine in number. To raise it, the trapezius and supra-spinatus are used; and to pull it a little inwards at the same time, the coracobrachialis, and a small share of the infra-spinatus are added. For drawing down the arm, the posterior parts of the deltoid muscle are used; and if we want to press it strongly against the side, we employ the great pectoral and latissimus dorsi, so that it is by this muscle that weight under the arm is supported. To bring the arm back, a combination of muscles is brought to co-operate, as the latissimus dorsi and teres major: but to pre-

vent these from rolling it, the *teres minor* and *infra-spinatus* are brought also into play, so that the arm is carried back in this way with considerable force: but if still greater force is wanted, some others of the forearm are brought to co-operate; and in order even to extend their power, we bend the elbow. For bringing the arm forwards, the large *pectoral*, the *coraco-brachialis*, and *latissimus dorsi*, are had recourse to. Thus, by a succession of such motions, the circular motion with the arm can be performed; besides which, the humerus can be rolled, and its powers exerted with great force, by bending the forearm. This we do in striking with a hammer, and the muscles we employ for the purpose are the *latissimus dorsi* and *teres major*, with the *subscapularis*; and farther assistance can be even given with the *pectoral* muscle; but the stroke is chiefly given with the three first, while the *teres minor* and *infra spinatus* roll the arm in the reverse way.

CCCCXII.

The motions of the elbow are more simple. For the purpose of flexion, the *biceps* and *brachialis externus* are employed; and for its extension, the *triceps* muscle.

CCCCXIII.

But, independent of these powers of the muscles, their actions may be considered in a still more extensive view. Thus, the muscles that

serve, to move the scapula, may be used to move the whole trunk; and a variety of muscles can be brought into action by forming as it were a chain, and influencing a distant member. Thus, suppose the body laid on the side in bed, and an attempt is made to raise it, the os humeri is first drawn down with the latissimus dorsi, and the muscles of the scapula, of the neck, and of the head, are gradually influenced; and thus the head and trunk is raised. Hence, the cause of pains in the side, &c. in the case of rheumatic affections, in consequence of motions made at a considerable distance; and, by fixing the scapula, humerus, and forearm, the trunk of the body can be acted on.

## CCCCXIV.



Viewing the muscles of the upper extremity, we must be struck with their amazing strength. In life a weight can be sustained by them that is sufficient after death to tear them in pieces.

## CCCCXV.

*Muscles seated on the Ribs.*

The peculiar muscles of the ribs that move them in respiration, claim the first attention in demonstrating those of the trunk.

## CCCCXVI.

*Serratus Superior Posuius.*

The first of this description is the serratus





superior psocticus, which lies flat upon the side of the neck, and arises by a broad thin tendon from the ligamentum nuchæ, or from the three lower vertebræ of the neck, and the two upper ones of the back. It passes obliquely downwards, and is implanted by a serrated edge into the 2<sup>d</sup>, 3<sup>d</sup>, 4<sup>th</sup>, and 5<sup>th</sup> ribs, under the upper and back part of the scapula. The purpose of this muscle is to expand the thorax, and by elevating the ribs, to dilate it in inspiration.

## CCCCXVII.

*Serratus Inferior Psocticus.*

This muscle lies under the latissimus dorsi, is broad and thin, and has its origin in common with the latissimus dorsi from the two inferior vertebræ of the back, and from the three superior ones of the loins. It is inserted in a serrated manner into the 9<sup>th</sup>, 10<sup>th</sup>, 11<sup>th</sup>, and 12<sup>th</sup> lower ribs, or their under edge, near their cartilages. The use of this muscle is to depress the ribs, and thereby to assist in contracting the cavity of the thorax in the time of expiration.

## CCCCXVIII.

*Levatores Costarum.*

These are no less than twelve muscles on each side, whose particular office is to lift the ribs. Their situation is either above or on the ribs, at their angles. Hence, their appellation of supra-



**costales.** In their shape they are nearly triangular. Their origin is from the transverse processes of the last vertebræ of the neck, and of the eleven superior vertebræ of the back; and descending obliquely forwards and outwards, they are inserted tendinous into the upper side of the ribs, near their tuberosities. Thus, the first of them beginning at the last vertebræ of the neck, descends for its insertion into the first rib; and so successively each arises in order, and is fixed to the rib below. The superior muscles are smaller, thinner, and shorter than the three last, which differ so far in their insertion, that they pass one rib to be attached to the rib below it, and hence they are named *levator longiores*. The use of this set of muscles is to lift the ribs directly upwards and outwards.

### CCCCXIX.

#### *Intercostales.*

But besides these muscles described, we find between the ribs, on each side, two rows of them, termed the external and internal *intercostales*. In their situation the external runs from the spine towards the sternum; and their fibres are directed in the same manner, or from behind, forwards. Their limits are the cartilages of the ribs. The internal again reverse this beginning from the sternum, and passing on to the spine; and their fibres observe the same direction, stopping at the angle

of the ribs. Hence they have been considered to decussate each other like the strokes of the letter X. By their action, the cavity of the thorax is expanded in consequence of the elevation of the ribs that takes place on inspiration. Some of the inferior portions of the internal intercostals passing one rib, are inserted into those below, which has occasioned their being described as separate muscles: but for this there is no proper foundation, as they are merely appendages that agree both in the same origin and use.

## CCCCXX.

*Sterno Costalis*

Is a triangular muscle, lying on the inner side of the sternum, and extended in three or four separate slips on the cartilages of the 3<sup>d</sup>, 4<sup>th</sup>, and 6<sup>th</sup> ribs. Its lowest portion arises from the ensiform cartilage, and has its insertion into the 3<sup>d</sup> and 4<sup>th</sup> rib; and its third portion, from the edge of the sternum, is inserted into the 3<sup>d</sup> rib. The fourth portion is often wanting; but goes generally from the 2<sup>d</sup> to the 3<sup>d</sup> rib. The use of this muscle is to press the ribs into which its insertions are made, and of consequence to assist in contracting the cavity of the thorax in expiration.

## CCCCXXI.

From this view, the power by which the motion of the ribs is performed, is beyond all doubt

the contraction of both the rows of intercostal muscles. At the same instant when these contract, the most moveable part is drawn towards one that is more fixed. The only difficulty here, and which has puzzled many anatomists, is to account for the obliquity of the intercostal muscles; and, next, why there are two rows of them. This difficulty depends on the want of observation of a circumstance of the first moment: that wherever extensive motion is required, oblique fibres are employed; the oblique fibres giving a greater play than the straight ones. Thus, as they contract more in proportion to their length, they bring the two ribs much nearer; and, in consequence of their being two rows, the obliquity of the one balances the obliquity of the other, and raises the rib in an equal way, neither pushing it backwards upon the spine, nor drawing it forwards upon the sternum.

## CCCCXXII.

But it still remains to explain, why the external intercostal muscles, which run all from above obliquely forwards, are wanting near to the sternum; and the internal, which run in a contrary direction, are wanting near to the spine. It clearly depends on the circumstance of both rows co-operating in raising the ribs; for, if the external row had been brought forward to the sternum,

the last fibres would have been fixed to the solid bone of the sternum, and would have drawn the ribs downwards. As soon, therefore, as they are brought so far forwards, that the distance at the place of insertion bears a considerable proportion to the distance of the origin of the muscles from the sternum, the muscle is wanting. In like manner, if the internal row went farther back, they would come to be fixed to the spine below, and to the rib above, at some distance from the head, which must have drawn the first rib down to the second one. This motion then of the ribs we find all in one direction; and it is greater as we go farther from the top of the thorax, the second rib having the motion of the first, and then its own motion, and so with regard to the rest.

## CCCCXXIII.

*Muscles of the Head and Neck.*

On removing the external muscle we have already seen, viz. the serratus superior posticus, the splenii then come into view; and after them the complexus is also exposed.

## CCCCXXIV.

*Splenius.*

This is a flat, broad, and oblong muscle, so named from a splint applied to a fractured bone. Joined by its fellow, the two have the appearance of the letter Y. In their situation, they are

placed immediately under the trapezii, and above the complexi.

The origin of the splenius is from the spinous processes of the neck and breast, and it is inserted into the back part of the head. It arises tendinous from the fourth and fifth spinous processes of the dorsal vertebræ, from the last one of the neck; and at the ligamentum nuchæ, it unites inseparably by tendon with its fellow. They afterwards recede; and it is inserted by two tendons into the transverse processes of the two first vertebræ of the neck, into the upper and posterior part of the mastoid process, and into a ridge in the occipital bone, where it joins with the root of that process.

Besides this part, which has been termed the splenius capitis, there is another portion lies under it, described as a separate muscle, under the name of the splenius colli. This part terminates by four or five distinct tendons in the transverse processes of the upper vertebræ of the neck, though it has the same common origin with the former.

By the action of the splenius, the head and upper vertebræ of the neck are turned obliquely backwards: when both splenii act, they pull the head directly backwards. They are the proper antagonists of the mastoid muscles.

## CCCCXXV.

*Complexus.*

The name of this muscle is derived from its complex structure. It arises by distinct tendons from the transverse processes of the seven superior vertebræ, of the back, and four inferior of the neck; and by a fleshy slip from the spinous process of the first vertebra of the back. In its passage upwards, it is intermixed with tendinous and fleshy parts. It is inserted into a depression under the large arched ridge of the occipital bone. The appearance of the muscle varies in different subjects, and it is sometimes divided on that account into two portions, the inferior being termed *biventer cervicis*, and the upper, which is seen in the fork of the *splenii complexus*. By its single action the head is drawn backwards and a little to one side; and when both act, it is pulled directly backwards.

## CCCCXXVI.

*Trachelo-Mastoideus.*

This muscle is so named from its origin and insertion, as also *complexus minor*. It arises from the three first vertebræ of the back, and from the five lowest of the neck, at their transverse processes. It is inserted into the mastoid process, just under the occipital insertion of the *splenius*. Its use is to assist the former muscle, but the head is drawn by it more to a side.

CCCCXXVII.

The next muscles that follow are the recti. In their situation they lie deep, and are divided into the major and minor.

CCCCXXVIII.

*Rectus Capitis Minor*

Arises from the first vertebra of the neck, and is the shortest of the two, being inserted fleshy into the occipital ridge. It assists its fellow in drawing the head backwards.

CCCCXXIX.

*Rectus Capitis Major*

Is larger than the former muscle, and has its origin from the external part of the spinous process of the second cervical vertebra. In its progress it becomes gradually broader, and goes obliquely upwards and outwards to be inserted into the occipital bone, at the outside of the insertion of the former. By the action of this muscle the head is pulled backwards, and its rotation also a little assisted.

CCCCXXX.

Similar to the recti muscles, except in their action, are the two obliqui; and like the former, they are divided into the major and minor.

CCCCXXXI.

*Obliquus Superior.*

The first, the obliquus superior, arises from the

transverse process of the first vertebra of the neck; and passing upwards and a little inwards, it becomes inserted into the occipital bone, at the outer part of the insertion of the rectus major. Its use is evidently to assist in drawing the head backwards.

## CCCCXXXII.

*Obliquus Inferior.*

This muscle arises from the spine of the second vertebra of the neck, and passes to the transverse process of the first, where it meets the former muscle. Its action is to roll the head, and thus by those oblique muscles, the short quick turnings of the head are performed. This last muscle moving the first vertebra upon the second.

## CCCCXXXIII.

When we observe in what manner the head can be moved, the combined action of the muscles in moving it is very simple. In general, every muscle draws its two points as much as the articulation will allow in a straight line, and all the muscles having slanting figures betwixt the head, draw it obliquely. But, if a pair of these are in action at the same time, the obliquity of the one balancing the obliquity of the other, they serve the purpose of a straight muscle. Thus, if we want to draw the occipital bone backwards in a straight line, instead of employing



muscles which run very nearly in that direction, we can employ the muscoli trapezii which run in a slanting direction, and the head moves in a diagonal between them, and by their means the head can be thrown much farther back than could be done by a muscle sent directly from the bottom of the neck to the occiput. If the head is to be drawn straight forwards, all the muscles are employed on both sides, whether straight or oblique; and in like manner, when it is drawn backwards. But, for pulling it sideways, we are obliged to employ an anterior and posterior muscle at the same time; so, in order to bring the mastoid process down to the shoulder, we act with the sterno-mastoideus and the splenius muscles, which counteract each other; and, by a succession of these motions, the head can be made to describe a circle. Thus if, for example, the nose is to be turned over the left shoulder, the most immediate for the purpose are the oblique inferior and superior, short, but very strong muscles; but we assist by the splenius of the same side, and to do it with its full swing, we also employ upon the opposite side the sterno-mastoid muscle and the complexus; for the splenius and complexus cross each other, and so are antagonists. The complexus, therefore, and splenius, on the opposite sides, have the same direction, and must co-operate; and inverting the action of these mus-

cles, the head is turned with the same force backwards.

## CCCCXXXIV.

*Muscles of the Trunk.*

The great muscles which move the back and loins, follow next in the order of our arrangement.

## CCCCXXXV.

*Quadratus Lumborum.*

The first of these is of a square or oblong form, and arises from the posterior part of the spine of the os ilium, and from the ligaments of the pelvis, which connect the ilium and sacrum. It is inserted into the transverse processes of all the lumbar vertebræ, into the last rib near the spine, and by a small tendon into the side of the last dorsal vertebra. By this situation, it is placed laterally at the lower part of the spine. By its single action, the loins are moved to one side; but joined by its fellow, they serve to support the spine, and perhaps to bend it forward. In laborious respiration, it perhaps also assists in pulling down the ribs.

## CCCCXXXVI.

*Longissimus Dorsi.*

This muscle arises from the back part of the os sacrum, spine of the ilium, and spinous processes of the vertebræ of the loins. It forms a large, thick, and strong muscle, which fills up

the hollow between the spine and the angles of the ribs. It gradually lessens in its ascent, and is inserted into all the transverse processes of the vertebræ of the back by small double tendons, and by a tendinous and fleshy slip into the lower edge of each rib, except the two inferior ones near their tubercles. The use of this muscle is to extend the vertebræ of the back, so as to keep the trunk of the body erect, and to draw it also back to one side.

## CCCCXXXVII.

*Sacro Lumbalis.*

Arises from the same origin as the former muscle; but it is farther from the spine, and it spreads its tendinous fibres broader upon the sides of the thorax. Externally, in its appearance, it is all tendinous; and, internally, it is all fleshy. Its insertion is into the lower edge of each rib, by an equal number of tendons. From the six or eight lower ribs arise an equal number of fleshy portions, which terminate in the inner side of this muscle, and get the name of muscoli ad sacro-lumbalem accessorii. The action of this muscle is to assist in raising and keeping the trunk of the body erect, in turning it upon its axis, or to one side, and in drawing the ribs downwards.

## CCCCXXXVIII.

Both this muscle and the former one, send up a fleshy slip from their upper part, which is

inserted into the 5th and 6th inferior vertebræ of the neck by so many tendons. These slips receive the names of *transversalis*, *cervicis* and *cervicalis descendens*. They, in action, turn the neck obliquely backwards, and to one side.

## CCCCXXXIX.

Thus, by the action of the muscles described, are the various motions of the trunk performed; for, by the first, or *quadratus lumborum*, it is inclined to one side; or, when both act, turned on its axis; and by the manner of insertion of this muscle is the breathing also assisted. The second muscle, or *longissimus dorsi*, has its action confined entirely to the spine, so as to keep it erect; in which it is joined by the *sacro lumbalis*, whose action, perhaps, is at the same time more extensive. Its slip will co-operate with the other muscles in that situation in turning the head to one side.

## CCCCXL.

The back is the seat of a number of small muscles, which extend on each side of it to the edge of the ribs; and these muscles have been divided by anatomists into a great variety. The first we shall consider is the

## CCCCXLI.

*Spinalis Cervicis.*

This set of muscles is implanted into the spinæ of the cervical vertebræ. It arises by distinct

tendons from the transverse processes of the five or six uppermost vertebræ; and ascending obliquely under the complexus, it is inserted by small tendons into the spinous processes of the sixth, fifth, fourth, third, and second vertebræ of the neck. Its action is to extend the neck obliquely backwards.

### CCCCXLII.

#### *Spinalis Dorsi.*

This muscle arises from two spinous processes of the loins, and from the three lower spinous processes of the back; and passing two, it is inserted into all the spinous processes of the back, except the uppermost. Its use is to extend the vertebræ, and to assist in raising the spine.

### CCCCXLIII.

#### *Semi Spinalis Dorsi*

Arises from the transverse processes of the lower vertebræ of the back all but two, and is inserted by small tendons into the upper spinous processes of the back, and the first of the spine. Its use is to extend the neck obliquely backwards.

### CCCCXLIV.

#### *Multifidus Spinae.*

This muscle arises tendinous and fleshy from the side and spinous processes of the os sacrum, and from that part of the ilium which joins with the sacrum, from all the oblique and transverse processes of the vertebræ of the loins, from all the

transverse processes of the vertebræ of the back, and of the four inferior of the neck. From all these origins the fibres of the muscle run in an oblique direction, and are inserted by distinct tendons into the spinous processes of all the vertebræ of the loins and back, and also into those of the six inferior vertebræ of the neck. The use of this muscle is to retain the spine from being too much bent forwards, similar to the use of a ligament. It also moves the spine backwards, and serves to erect it.

## CCCCXLV.

*Interspiniales Colli*

Are the double fleshy portions that occupy the spaces between the spinous processes of the vertebræ of the neck, most of which are forked. They have their origin from each inferior spinous process, and their insertion into each superior. By their action, these processes are drawn nearer to each other, and of course the neck is pulled a little backwards.

## CCCCXLVI.

*Intertransversales Colli*

Differ from the former in their situation, which is between the transverse processes of the vertebræ of the neck. They are also forked, and are filled up in like manner with double fleshy portions. Their action is to draw these processes towards

each other, and to turn the neck a little to one side.

CCCCXLVII.

*Interspinales et Intertransversales Dorſi*

Are ſmall tendons that ſerve to connect the ſpinal and tranſverſe proceſſes.

CCCCXLVIII.

*Interſpinalis Lumbarum*

Are the ſame as the former, and require no particular deſcription.

CCCCXLIX.

*Intertransverſalis Lumbarum.*

Theſe are five diſtinct muſcles that occupy the ſpaces between the tranſverſe proceſſes of the laſt dorſal, and all the lumbar vertebræ, and ſerve to draw them a little to each other.

CCCCCL.

Having finiſhed the muſcles of the trunk, we obſerve that its motion are more ſimple than thoſe of the extremity. For moving it ſideways, we employ thoſe muſcles immediately connected to the vertebra; and, in its other motions, we take the aſſiſtance of the abdominal muſcles, and others not yet deſcribed. The muſcles of the forepart of the head and neck ſtill remain to complete the ſpine.

CCCCCLI.

*Platiſma Myoides.*

This is properly a thin muſcular expansion re-

sembling the subcutaneous muscle of quadrupeds, and arising by a number of separate fleshy slips which cover the upper part of the pectoral and deltoid muscles. It runs obliquely upwards along the side of the neck, and is inserted into the side of the lower jaw, into the depressor anguli oris, and into the skin which covers the under part of the masseter muscle and parotid gland. This part, by its action, will assist in depressing the skin of the cheek, the corner of the mouth, and the lower jaw; and when the jaws are shut, it will tend to raise all that part of the skin connected with it under the lower jaw.

## CCCCLII.

*Mastoideus.*

The mastoid muscle is divided in its origin between the clavicle and sternum, and has been distinguished accordingly by the name of sternokleido mastoideus; but its sternal point forms its principal attachment. On the union of its heads, a little above the clavicle, it forms a strong muscle which runs obliquely upwards and outwards, and it is inserted into the mastoid process by a broad tendon surrounding it, and which is even extended somewhat farther. The office of this muscle is to turn the head to one side, and to assist in rolling it. When both muscles act, they bow the head, or pull it directly forwards.



## CCCCLIII.

Next to the mastoideus, follow three muscles lying under the œsophagus and trachea, flat upon the forepart of the vertebræ. The first of these is the

## CCCCLIV.

*Rectus Internus Capitis Major.*

The origin of this muscle is from the transverse processes of the 3d, 4th, 5th, and 6th vertebræ of the neck, and it is inserted into the cuneiform processes of the occipital bone, just before the foramen magnum. Its action is to bend the head forward.

## CCCCLV.

*Rectus Capitis Minor.*

This small muscle lies immediately under the former. It arises from the forepart of the body of the first vertebra, and going obliquely inwards, it is inserted into the occipital bone near the condyle. By its action it assists the former muscle.

## CCCCLVI.

*Rectus Capitis Lateralis*

Arises from the anterior part of the transverse process of the atlas. It passes obliquely outwards, and is inserted into the side of the cuneiform process of the occipital bone. It lies immediately under the passage of the great jugular vein.

## CCCCLVII.

*Longus Colli.*

This is the principal muscle on the forepart of the neck. Its origin is from within the thorax, from the side of the bodies of the three superior vertebræ of the back, and from the transverse processes of the four inferior of the neck. It is inserted tendinous into the forepart of the bodies of all the vertebræ of the neck, by as many small tendons which are covered with flesh. By its action it bends the neck forwards and to one side, or when both muscles act, they immediately bend the neck.

## CCCCLVIII.

*Scalenus.*

This is one great triangular muscle, flat, and stretching from the ribs to the neck, closing as it were the thorax above, and giving passage to the nerves and vessels of the arm. It has been divided by anatomists into several parts; but these may be confined properly to three.

The anterior portion arises from the transverse processes of the six inferior vertebræ of the neck, and is inserted into the flat part of the first rib, hard by its cartilage. The origin of the middle portion is from the four last vertebræ of the neck to the outer edge of that rib, extending along it all its length; and the posterior portion arises from the transverse processes of the 2<sup>d</sup>, 3<sup>d</sup>, and 4<sup>th</sup>

vertebræ, being inserted into the upper edge of the rib, at the distance of about  $1\frac{1}{2}$  inch from its articulation with the spine. Through the first portion, the artery passes about an inch above the axilla, and the nerves pass in the interstice between the first and second portion. The office of this muscle is to move the neck to one side when acting singly; but when both act, they move it forward; and when the neck is fixed, they perhaps also assist to raise the ribs.

## CCCCLIX.

From the muscles of the trunk, we now proceed to those of the abdomen, or belly; which, while they cover this cavity, take a strong hold both of the trunk and pelvis; and this cavity is also divided from the trunk by a strong muscular partition, constantly in action, termed the diaphragm. From the various and important offices of these abdominal muscles, as well as of the diaphragm, their consideration is a subject of much importance.

## CCCCLX.

The abdominal muscles are ten in number, five on each side. The three first, or the two oblique and transversalis, by their broad layers fill up the space between the cartilaginous edges of the false ribs and the bones of the pelvis; and the union of their tendinous fibres with each other from the

opposite side, fill a space termed the linea alba, extending from the ensiform cartilage to the pelvis. The two last muscles, the rectus and pyramidal, have their situation at the side of this linea alba.

# CCCCLXI.

## *Obliquus Externus.*

The first, or obliquus descendens, is a broad, thin, serrated muscle, situated immediately under the teguments, and arising by indentations from the eight lower ribs. Its fibres run obliquely downwards and forwards; and one half of it, or its fleshy belly, covers the back part of the abdomen, while the fore part is covered by its tendinous expansion. It is inserted into its fellow of the opposite side by the linea alba, formerly noticed, which extends from the ensiform cartilage to the pubes, formed by the meeting of the tendons of the oblique and transverse muscles of the abdomen, and perforated in the middle by the umbilicus, originally the exit of the umbilical vessels, now formed into a cicatrix. It is inserted also into the anterior half of the spine of the os ilium and ligament of Poupart, which is a distinct ligament, and not the tendon of the external oblique, stretching from point to point. The use of this muscle is to draw down the ribs in expiration, to bend the trunk forward when both muscles act,

or to bend it obliquely to one side, or turn it on its axis when operating singly. It also raises the pelvis obliquely, when the ribs are fixed; and, by supporting and compressing the abdominal viscera, it assists all the evacuations that take place in the under belly.

## CCCCLXII.

*Obliquus Internus.*

This muscle is situated immediately under the external oblique, and arises from all the circle of the spine of the ilium, from the joining of the ilium and sacrum, from the spine of the sacrum itself, from the three lower spinous processes of the loins, and from the ligament of the thigh. From these origins it proceeds upwards in a radiated form, but the greater part passes up in a slanting direction. It is inserted into the cartilages of all the false ribs, into the sternum, and into the linea alba, for its whole length. The use of this muscle is to assist the former; but it seems more evidently calculated than that muscle to draw the ribs downwards and backwards. It also serves to separate the false ribs from the true ribs, and from each other.

## CCCCLXIII.

*Transversalis.*

This muscle runs directly across the belly. It arises from the cartilages of the seven inferior ribs, from the transverse processes of the last

dorsal and four upper lumbar vertebrae, from the spine of the ilium, and from a part of the femoral ligament. Thus its origin resembles that of the former muscle. Its fibres cross the abdomen, and it is inserted tendinous into the linea alba its whole length, and into the ensiform cartilage. The use of this muscle is evidently to support and immediately compress the abdominal viscera.

## CCCCLXIV.

This first division of the abdominal muscles is thus situated in relation to each other. The external oblique is expanded broad upon the chest on its outside. The internal is placed lower and more to a side, or towards the edge of the cartilages; while the transverse takes its origin within the chest, or from the internal costal surface.

## CCCCLXV.

*Recti.*

The recti muscles form the first or anterior covering of the abdomen, and extend from the sternum to the pubes. The former of these is their origin, which is broad and fleshy, covering the outside of the sternum and its cartilage. It then extends down the abdomen of four inches breadth, and terminates by a flat pointed tendon at the symphysis. It is crossed in its course by different tendinous intersections, of which there are observed three above, and two below the

umbilicus. Its office is to compress the forepart of the abdomen, to draw down the ribs, and to bend the trunk forward, or raise the pelvis. By its tendinous interfections, its action is preserved more regular.

## CCCCLXVI.

*Pyramidalis.*

This muscle is evidently an appendage to the former. It arises from the anterior and upper part of the pubis, and is inserted into the linea alba and inner edge of the rectus, commonly about two inches above the pubis. Its use is to assist the rectus to draw down the sternum, and tighten the linea alba, thereby increasing the power of the other muscles, particularly the lower portion of the rectus. This muscle often differs on the two sides, and is sometimes entirely wanting in one.

## CCCCLXVII.

Having thus seen the several muscles of the abdomen, we observe that as the rectus is pushed out in a convex line when it acts, it brings itself straight, and therefore pushes in the belly and compresses it. Next, when it is brought into a straight line, and that we are in a state of full inspiration, it will draw down the lower ribs, and assist in performing expiration; but, if the ribs are brought down, and we wish to bend the thorax or to push any thing away before us, we move the

whole upper part of the body by means of it, or we draw the thorax nearer to the pelvis. The last effect is that, if the thorax be fixed, the pelvis will be drawn up towards the thorax. The pyramidalis concurs to produce these effects, and serves farther to compress the bladder.

## CCCCCLXVIII.

With regard to the oblique muscles, their action may be reduced to the greatest simplicity; for the external oblique of the one side has its fibres in the same direction with the internal of the other, so they may be considered as forming one digastric muscle, and the same takes place with regard to the other two. Thus, when we draw down the thorax or raise the pelvis with a degree of obliquity, these muscles are employed, but in other respects their action is similar to that of the recti; for, if we act with them all, the slanting direction of the one balancing that of the other, the body is moved straight.

The only remaining muscle is the transversalis. It can have very little effect in drawing down the ribs, and its action is very much confined to the constriction of the belly, so it reaches from bone to bone, and nature has thrown in a vast deal of tendon; for, if the flesh had been continued, it would have straightened the belly too much. Thus it is continued in sheaths, and the effect of these is to increase the action of



the rectus muscle, and we accordingly do employ the transversalis when we want to have its action more considerably increased.

## CCCCLXIX.

With regard to the oblique, we find that the degrees of motion performed by them are greater than could have been made by straight muscles. This is a circumstance entirely overlooked, yet the influence of it is very powerful; the obliquity of the one muscle balances the obliquity of the other, as already stated, when the body is brought forwards, and here the action is a good deal more extensive than it otherwise could have been. Thus, suppose an action to be required by the rectus muscle, and that the rectus can shorten itself  $\frac{1}{3}$  of its length, and the thorax would have been drawn so much down. When two such muscles are placed slanting, and the obliquity of the one balances the obliquity of the other, the action is much more extensive. In this part of the body, it is not often that we have occasion for so great an extent of motion; but between the ribs, where the space left for motion is very small, this contrivance is very useful and necessary.

## CCCCLXX.

Besides what has been observed, it is by the action of the abdominal muscles that the contents of the belly are carried downwards, delivery is

assisted, the circulation of the blood through the liver promoted, and by their influence on the trunk, even the actions of the lower extremities forwarded; by violent action with them, even the contents of the stomach can be thrown up by vomiting.

## CCCCLXXI.

Connected with the muscles, some parts of the abdomen already noticed deserve a farther detail.

## CCCCLXXII.

*Linea Alba.*

The first of these is the linea alba, or common meeting of the tendons of the abdominal muscles on each side, which becomes of course their common point of action.

## CCCCLXXIII.

The second is the femilunar line, formed on the edge of the rectus muscle, in order to form a sheath for it of a circular form.

## CCCCLXXIV.

The third is the sheath of the rectus itself, which is a separation of the tendons that meet in the femilunar line. Thus, the flat tendons of both the oblique muscles go upon the outer surface of the rectus, and the sheath is formed on that side, while the tendon of the transverse lying under the rectus, forms its lower part. At the forepart again, or over the muscle itself, the sheath is complete till it stops about five or six

inches above the pubes, where the pyramidal muscles are situated, and which have no intervening covering between the internal cavity but the peritoneum. The back part of the sheath possesses little attachment, and is easily raised; but the forepart of it adheres firmly to the muscle, forming the intersections which divide it into separate bellies, and a separation cannot be made at this part without injuring the muscle.

## CCCCLXXV.

The umbilicus is the central opening of the abdomen, placed in the middle of the linea alba, and giving exit to the foetal nutriment through its vessels. In the adult, the extremities of these vessels degenerate into ligament, and the part closes in the form of a ring. This opening, however, is at times forced by violent action of the abdominal muscles or other exertions.

## CCCCLXXVI.

A lower opening, just over the pubes, and a highly important one, is the ring of the abdominal muscle through which the spermatic vessels pass in men, and the round ligaments of the uterus in women. This ring is formed by the external oblique muscle, the tendon of which forms a split, which begins about an inch and a half above the pubes. It is oblique, and consists of two legs, looking towards the pubes. The upper one, or pillar,

• which forms the superior part of the opening, goes directly towards the crest or highest point of the pubes, the lower pillar or slit forming the low line of it, turns in behind, gets under the upper one, and is implanted into the pubes within and behind the upper pillar, and this part forms at once the inferior part of the ring and the edge of the ligament. By this crossing of the pillars is the ring secured, and the more muscle pulls in its action upon the abdominal viscera, the tighter is the opening drawn. Through this ring the spermatic cord passes, and at the place where it passes the internal oblique muscle, the latter sends down with it a bundle of fleshy fibres which spread over it, extend to the testicle, and are there expanded on the upper part of it.

## CCCCLXXVII.

This bundle, or expansion, is termed the cremaster muscle of the testicle, which is designed for suspending it, and drawing it up. It is strong in animals, but is thin in the human subject, and sometimes is hardly to be distinguished from the teguments. It acquires thickness from disease of the testicles.

The ligament of the thigh arises from the spinous processes of the ilium, and is inserted into the crest of the pubes. The tendon of the oblique muscle is implanted into it, and part of the flesh of the muscle arises from its outer end. By this ligament an arch is formed for the passage of the

psoas and internal iliac muscles, and for the great artery of the thigh and its anterior nerve. By it also are returned the great vein and the lymphatics of the limb, and the inguinal glands are situated there. Its whole interspace is filled with fat and cellular matter, though its texture is not firm.

## CCCCLXXVIII.

*Diaphragm.*

The diaphragm, or midriff, is the transverse partition betwixt the abdomen and the thorax. It forms a vaulted division between the chest and belly; having also a considerable obliquity, that while its forepart is as high as the sternum, its lower and back part arises from the lowest vertebræ of the loins, near the pelvis.

## CCCCLXXIX.

This muscle is of a circular form. In its centre it is tendinous; but arises by fleshy borders. It is concave below, and convex above; and when it presses against the abdominal muscle in drawing the breath, it becomes in its form nearly plain; and when the abdominal muscles meet, it is again pushed back to its convex form. It arises by one broad attachment from all the borders of the chest, and thus is formed its large division; while below, its origin is from the forepart of the loins by many small tendinous slips, the union of which is termed the lesser division. To examine it more particularly, we observe that the

• upper division arises by fleshy indentations from the ensiform cartilage, and from the cartilages of the 7<sup>th</sup> and all the inferior ribs on both sides. In their course its fibres run in a radiated manner, and they are inserted into a cordiform tendon placed in the middle of the diaphragm, and in which the fibres of the opposite sides are interlaced. Towards the right side, the tendon is perforated by a triangular hole for the passage of the vena cava inferior, and to the upper convex part of it the pericardium and mediastinum are connected.

## CCCCLXXX.

The origin of the lesser diaphragm is from the spine, by four small tendinous heads on each side. The first of these, or longest, arises from the second vertebra above the pelvis, and adheres to the bodies of all the vertebræ of the loins above this, by the intervention of the common ligament covering the bones. In their ascent they leave an oval opening for the passage of the aorta and thoracic duct. The other heads arise from the third, and also from the second lumbar vertebra, and are placed farther out. From the different heads, the muscular fibres run upwards, and form in the middle two fleshy columns which decussate and leave an opening for the passage of the œsophagus. It is inserted by fleshy fibres into the posterior edge of the cordiform or middle

tendon. Thus is the diaphragm composed of one great and circular muscle before, of one smaller one behind, of a triangular tendon the centre<sup>a</sup> between these muscles, and both at its tendinous and fleshy parts it has perforations for the large vessels passing between the thorax and abdomen. The lower surface of the diaphragm is lined with the peritoneum or membrane of the abdomen, and the upper surface is covered with the pleura or membrane of the chest. The hole for the vena cava is so large, that the peritoneum and pleura meet in contact round this vein. The office of this muscle is chiefly in breathing, and independant of the action of the ribs, it is capable of completing this function. In its natural state the diaphragm is convex towards the chest. By its action, however, it loses its convexity, and becomes plain. By this the thorax is enlarged, while the weight of the air unfolds the lungs, which of course follow the diaphragm. There is no space ever between this muscle, and the lungs, and the ribs, and the diaphragm, are closely encircled by them, almost as if they were their internal lining; and, indeed, they become so in some measure by forming occasionally adhesions. The ascent or return of this muscle in expiration, is performed by the contraction of the abdominal muscles, which is alternate with that of the diaphragm. By their means it yields, goes back

into the thorax, and grows convex again. The gentle pressure which all the abdominal vessels receive from this constant and regular motion, cannot fail to assist in the performance of their several functions. But there are certain circumstances in which the abdominal muscles and the diaphragm act all at one time, and by this means the cavity of the abdomen is diminished, and its contents more forcibly compressed. This is what takes place in parturition, in the expulsion of the fœces, and in vomiting. Besides these uses, the acts of coughing, sneezing, speaking, laughing, gaping, and sighing could not take place without this muscle assisting, and they may be considered as its irregular actions. Hence, the variety of its offices may well make it deserve to be considered in the language of Haller, as, *Nobilissimus post cor musculus*. In this part, indeed, all our feelings seem as it were to concentrate.

## CCCCLXXXI.

*Muscles of the Parts of Generation, and Parts contiguous.*

The division of the abdominal muscles last demonstrated is naturally followed by those of the genital organs, and of the anus and perineum.

## CCCCLXXXII.

*Erector Penis.*

The first is the erector penis, a small slender muscle passing over the anus, and bending it back



to the pubes. It arises from the inner side of the tuberosity of the ischium. It runs up fleshy, increasing in breadth, and embracing the whole crus penis, and is inserted by a thin tendon into the elastic membrane which covers the corpora cavernosa penis as far as the union of the crura. By its action it compresses the crus penis, and pushes the blood from it into the forepart of the corpora cavernosa in the time of its distension. It is likewise supposed to give a proper direction to the penis.

## CCCCLXXXIII.

*Accelerator Urine*

Is a muscle that surrounds all the bulb of the urethra, and acts by a sort of jerk in discharging the last drops of the urine, and in throwing out the semen. It arises fleshy from the sphincter ani and the membranous part of the urethra, and tendinous from the crus and beginning of the corpus cavernosum penis. In its course it forms a thin fleshy layer, the inferior fibres of which run more transversely than the superior, which descend in an oblique direction, the muscles on the opposite sides completely enclosing the bulb of the urethra. By a tendinous line running longitudinally on the middle of the bulb, it is inserted into its fellow. By the action of this muscle, the urine and semen are propelled forward; and, by compressing the bulb, the blood is pushed into,

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and thereby distends the corpus cavernosum urethræ and glans of the penis.

### CCCCLXXXIV.

#### *Transversalis Perinæi or Penis.*

This muscle arises from the inside of the tuberosity of the os ischium, close to the erector penis. It is inserted into the very backmost point of the bulb of the urethra, where it touches the anus. Its course is directly across the perineum, and its relation to it and the anus is more apparent than to the penis. There is often another muscle of the same origin, which runs along with the former, but rather more obliquely upwards. This muscle in its action, by bracing up the bulb to the arch, may have some effect in stopping the vein on the back of the penis, and so in producing erection; but its principal office must be to prevent the anus being too much protruded in the discharge of fœces, and in drawing it back when protruded.

### CCCCLXXXV.

#### *Sphincter Ani*

Is a broad circular band of fibres surrounding the anus. Its origin is from the point of the os coccygis behind. . It runs forward within the skin and fat that covers the verge of the anus. It sends out a neat small slip, by which it is attached to the back part of the accelerator muscle. It is

## cclxxxviii DEMONSTRATION

of a regular oval form, and is two inches broad, being stronger in man than in animals. The action of this muscle is to shut the anus, and also to pull down the bulb of the urethra, by which it may assist in throwing out the urine and semen.

This muscle is sometimes seen divided into two parts, an external, as demonstrated, and an internal, which is merely the circular muscular coat of the end of the rectum.

### CCCCLXXXVI.

#### *Levator Ani.*

The levator ani is one broad thin muscle which arises from the internal surface of all the forepart of the pelvis, and from its breadth it has been termed the broad muscle of the anus. Its origin is by a semicircular edge from the os pubis within the pelvis, at the upper edge of the foramen thyroideum. It grows gradually smaller as it goes downwards to surround the anus, into the circle of which it is inserted, into the point of the os coccygis, and is mixed with the muscle of the sphincter. Thus the whole pelvis is lined by it, and it has been compared to a funnel or inverted cone, the wider part representing its origin, the narrower its insertion. By this muscle the whole bladder is surrounded. Through an opening in its fibres the urethra finds a passage. It raises and dilates the anus for the discharge of feces,

and by the support it gives, prevents its protrusion. Hence, from its use, it is the antagonist of the sphincter, and by its action it forms a sphincter of the bladder. From the situation also of this muscle with respect to the genital parts, the vesiculae are emptied by its action, the fluid compressed, and as it pulls upwards at the same time, the back of the penis is pressed against the pubes, erection maintained, and the accelerator muscles assisted by it. Under morbid irritation of any of the parts of the pelvis, from the general connections of this muscle it is communicated by means of it to the whole of them; and hence, the uneasy symptoms that are produced as a consequence of sympathy in these cases.

## CCCCLXXXVII.

*Musculus Coccygeus.*

This thin flat muscle arises by a narrow point from the spinous process of the ischium. In its passage it gradually expands, and is implanted into the whole length of the os coccygis. Its only office can be to draw up the point of the os coccygis, and thus to raise the circle of the anus. Hence it corresponds in some degree with the levator ani.

## CCCCLXXXVIII.

*Perineum.*

The perineum, or beginning of the bulb, is the uniting point of all the muscles; by the crossing

and union of which it is secured, and the heavy abdominal viscera supported.

### CCCCLXXXIX.

Having described the muscles belonging to the genital parts of the male, those of the female fall next to be demonstrated. There are, however, only two peculiar ones, the first of which is the

### CCCCXC.

#### *Erector Clitoridis.*

It is smaller than the erector penis of the male, but is implanted in a similar manner into the crus and body of the clitoris.

### CCCCXCI.

#### *Sphincter Vaginæ.*

The other muscle is the sphincter vaginæ. It arises from the sphincter ani, and from the posterior side of the vaginæ, near the perineum. It passes along the outer end of the vagina, covers the corpus cavernosum vagina, and going behind the nymphæ, it is inserted into the union of the crura clitoridis. By its action, the external surface of the vagina is contracted by compressing its corpus cavernosum, from which last it also pushes the blood into the nymphæ and clitoris.

### CCCCXCII.

#### *Muscles of the Inferior Extremity.*

To finish the description of the muscles, those of the inferior extremity still remain, which are divided into those of the thigh, leg, and foot.

## CCCCXIII.

*Muscles of the Thigh.*

All the muscles of this part take their origin from the pelvis or trunk; and, previous to their description, it is proper to notice the tendinous expansion, or fascial sheath, in which they are involved. This part, similar to what occurs in the arm, forms a general covering to the muscles, and sends off partitions between them, in which they are inclosed, which give them strength and support in their exertions. Above, it adheres to the outer top of the os innominatum, and communicates with the tendon of the external oblique; lower down, it spreads itself over the joint of the knee, and from thence it passes on to the leg. In its progress it is always receiving additions at different places. On the outside of the thigh and leg it is of great strength and thickness, but towards the inner side of both, particularly the former, it gradually turns thinner, and has rather the appearance of cellular membrane. A little below the great trochanter it is firmly connected to the linea aspera, and at the joint of the knee it receives additions from the tendons of the extensors of the leg, and is there connected with the outer and inner heads of the tibia and fibula. In the leg it is firmly fixed to the spine of the tibia, and at the under end to the bones of the ankle, where part of it is thicker and

stronger than the rest, and forms the annular ligament of the tarsus. It is lost at last upon the foot.

## CCCCXCIV.

The connections of this sheath, from the description given, are numerous. They begin at the crest of the ilium, at the ligament of Poupert, and at the crest and arch of the pubes. They come on to the tuber ischii, and back, along the coccyx, to the ridge and processes of the sacrum. They are then connected with the ligament of the joint, the great trochanter, and the linea aspera all the way down to the knee, where its last adhesion is very strong, and where it receives additional layers.

## CCCCXCV.

*Facialis.*

The facial muscle is the first of this part to be demonstrated. It is properly the tensor vaginæ femoris. It arises by a narrow beginning from the upper spinous process of the ilium, by means of a tendon an inch in length. It is equally narrow at its insertion, a little below the great trochanter into the inner surface of the aponeurotic covering. Its chief office is to tighten the fascial covering, and prepare the muscles for strong action. It may, perhaps, also, have some effect in rolling the thigh, and turning the toes inwards.

## CCCCXCVI.

*Psoas Magnus*

Is a large round muscle, filling up all the space upon either side of the spine, and at its side bounding the pelvis. It arises from under the ligamentum arenatum of the diaphragm, from the last vertebra of the back, and successively from each of the vertebræ of the loins. It is inserted into the sacro iliac symphysis, and along with the internal iliac muscle it descends through Poupart's ligament. The action of this muscle is to move the thigh forwards; it is of constant use for this purpose, or to support the pelvis upon the thigh bone.

## CCCCXCVII.

*Psoas Parvus.*

This is a muscle of the loins. It arises fleshy from the last vertebra of the back, and one or two upper vertebræ of the loins. It ends in a slender tendon which runs down by the side of the psoas magnus, and stops short within the pelvis, being inserted into the os ilium, near the place of the acetabulum. This muscle is sometimes wanting in both sexes, but oftener in men than in women. In some cases, three muscles of this name are met with. The use of this muscle is to assist in bending the spine upon the pelvis, or in raising the pelvis.



## CCCCXCVIII.

*Iliacus Internus.*

The whole concavity of the ilium is the seat of this muscle. Its origin is from the transverse process of the last lumbar vertebra, from all the edge of the iliac spine, from the forepart of the bone under the spinous process, and from a part also of the capsular ligament of the joint. At Poupert's ligament its fibres form a tendon. This tendon is larger at the lower than upper surface, gliding on the pubes, and connected only by loose cellular substance. It is implanted into the lesser trochanter. The action of this muscle is to assist the psoas in bending the thigh. They are both muscles of great power. Along with them the large blood vessels descend, and they are all covered with loose cellular substance.

## CCCCXCIX.

*Pectinealis.*

This is a broad square muscle arising at the pubes, and lying along side of the last, having its insertion along with their tendon. Its origin is from the anterior edge of the os pubis, and it is inserted by a long flat tendon into the linea aspera, at its upper and forepart. The use of this muscle is to bend the thigh bone, and close the knees together. It likewise assists in rolling the thigh bone outwards.

## D.

*Triceps Femoris*

Arises from the pubes with three heads, which are so much unconnected, as to be commonly described as three separate muscles, under the names of the abductor primus or longus; the secundus or brevis, and the tertius or magnus.

The 1<sup>st</sup> is the uppermost flat layer which ranges with the border of the pectinalis. Its origin is by a strong roundish tendon from the upper and fore part of the pubes, and running downward and outward, it has its insertion by a broad flat tendon into the line of the linea aspera at its middle. Thus the muscle is of a triangular form with its base in the linea aspera, and its apex on the pubes.

The 2<sup>d</sup>, or brevis, arises at the side of the symphysis pubis, below and behind the former by a thick flattened tendon, and it is again inserted by a short one into the inner trochanter and linea aspera. Its difference from the former is in being less oblique, and going more immediately across.

The 3<sup>d</sup>, or magnus, arises also from the side of the symphysis pubis, a little lower than the former. It is long and flat, and is the most internal of the three. Its origin is broad, and its termination is implanted into the thigh bone the whole length of the linea aspera, which gives

its fibres various degrees of obliquity. By this muscle a flat partition is formed betwixt the fore and back parts of the thigh. The great artery is also perforated by it to get from the fore to the back part of the thigh, and down into the ham.

The action of these three muscles is the same. To bring the thigh inwards and upwards, according to the different direction of their fibres, and to assist a little in rolling the thigh outwards, in doing which they possess great power from the distance of their origins from the centre of the bone which they move.

## DI.

### *Obturator Externus*

Takes its name from the ligament that forms its origin and which shuts up with the muscles the thyroid hole. It arises from the ramus of the ischium and pubes by a semicircular margin, and is a short conical muscle, with a broad origin and narrow insertion. This insertion is into the cavity at the inner and back part of the root of the trochanter major; and, by the tendon twisting as it were under the thigh bone, it is in a manner rolled round it. Its chief action appears to be rotation, and it likewise prevents the capsular ligament from being pinched in the motions of the joint.

## DII.

*Glutæi.*

Under this name are included three muscles which help to form the buttocks on each side. They are disposed in layers under each other, and each smaller than the one that covers it.

## DIII.

The first is the *glutæus maximus*, which is a broad radiated muscle arising from the back part of the spine of the ilium, from the under and outer part of the sacrum, or all its spines, and from the sacrosciatic ligament. Its fibres proceed in a winding direction down the thigh till gathered into a flat thick tendon, which is inserted into the upper and outer part of the *linea aspera*, along which it continues for some way down. This muscle is considered as one of the largest of the body, and by it is formed the contour of the hip. Its action is to pull the thigh directly backwards, or the body forward upon the thigh when the thigh is fixed; and, in doing this, its different parts act with different effect, according to their direction, and the particular position of the pelvis. By its origin from the coccyx, that bone is prevented from being forced too far backwards.

## DIV.

*Glutæus Medius.*

The second muscle is the *glutæus medius*, resembling in its shape the former. It arises

from the spine and superior surface of the ilium not occupied by the former muscle. It possesses a radiated or converging form, and is gathered into a short flat tendon which is inserted into the outer and back part of the great trochanter. The uses of this muscle correspond with the former. Its proper office is to assist in pulling the thigh backwards, and moving it outwards from the body; but, as certain portions of it lie also before the thigh bone, these may have an effect in pulling it forward.

## DV.

*Gluteus Minimus.*

This small radiated muscle lies deep under the former, in older subjects having its outer surface usually tendinous. It arises from the lower half of the dorsum of the os ilium, which is continued to the great sciatic notch, when it is gathered into a strong flat tendon, and inserted into the upper and fore part of the great trochanter. This muscle assists the two former in drawing the thigh backwards and outwards, and in rolling it. It may serve likewise to prevent the capsular ligament from being pinched on the motions of the joint.

## DVI.

The glutei muscles then are placed in a regular succession; the great gluteus is inserted below the root of the trochanter, and into the linea aspera;

## AND DISSECTION.

ccxcix

the middle one into the back and top of the trochanter, and the small one into the rough part under the root of it.

### DVII.

#### *Gemini.*

This simple bicipital muscle, from the distinctness of its heads, has been generally described as two, under the name of *gemini*.

The upper one, the longest and strongest, arises from the spinous process of the os ischium, and the small one from the tuber or ball on the outer end of the same bone. In their course they are fleshy, and meeting at last, they unite their tendons in the great trochanter, at the root of which process they are firmly inserted. Their action is to roll the thigh outwards, and to prevent the tendon of the obturator internus from slanting from its muscle while the muscle is in action.

### DVIII.

#### *Pyriformis.*

This muscle, named the internal iliac and pyramidalis, proceeds from the hollow of the sacrum, rising by three tendinous and fleshy heads from its 2d, 3d, and 4th pieces. As it passes out of the pelvis, it becomes round and tapering, and is inserted into a cavity at the inner side of the root of the great trochanter. Its chief action is to assist in rolling the thigh outwards, and in moving

## DEMONSTRATION

it a little upwards. Its name is derived from its shape.

### DIX.

#### *Obturator Internus*

Is a considerable muscle, the chief part of which is situated within the pelvis. It arises within this cavity by a semicircular fleshy margin from the anterior half of the thyroid hole, and in part from the obturator ligament. Its fibres converge and send off a round tendon which passes over the os ischium, in the manner of a rope over a pulley, between the spine and tuber of that bone. Its tendon is joined as it passes between the two legs of the gemini to theirs, and it is inserted along with the gemini into the root of the great trochanter. By its action this muscle rolls the thigh obliquely outwards, by pulling it towards the sacrosciatic niche.

### DX.

#### *Quadratus Femoris.*

This thin flat muscle passes in a transverse direction betwixt the tuber ischii and the thigh bone. It arises from the tuber ischii at its low flattened surface, and proceeding somewhat obliquely upwards and outwards, it is implanted into the back of the great trochanter, in the roughness joining it to the bone. The office of this muscle is to bring the os femoris out-

## DXI.

The muscles of the thigh, we find, are strong and varied in their motions. Their strength is necessary from their situation in supporting the body; and, from the mode of their insertion, which is only the two points of the trochanter, none of their motions can be direct, and a chief part of the muscles bends round the thigh bone to get at the place of their insertion; one half on the outside of it, and the others on the inside. The first are termed abductors, and pull it outwards; the second are termed adductors, and draw the thighs together.

## DXII.

*Muscles of the Leg.*

The actions of the leg being merely those of flexion and extension, its muscles are simple, and they are divided accordingly into two classes, of flexors and extensors.

## DXIII.

*Rectus Femoris.*

The first of the extensors is the extensor femoris or rectus cruris, so named from its direction, being a flat thin muscle, arising by two heads. The first and shortest head proceeds from the outer surface of the inferior and anterior process of the ilium; the posterior tendon, which is thicker and longer than the other, arises from the posterior and outer edge of the cotyloid cavity, and from the adjacent capsular ligament. These heads join-



ing together, form a flat tendon of four inches in length, which gradually enlarges and becomes fleshy to its middle, when it contracts towards the patella in the same gradual manner. On the back part of this muscle there is a middle tendinous line, very conspicuous, and towards it, as a centre, all the muscular fibres converge. The action of this muscle is to extend the leg, and it is united at its sides to the vasti, and at the back part to the cruræus.

## DXIV.

*Rectus Cruris.*

The rectus cruris is composed of three great muscles, the cruræus, and the two vasti, that inwrap the whole of the thigh bone.

## DXV.

*Cruræus.*

The first, or cruræus, is situated under the rectus and between the vasti. It arises from the fore part of the trochanter minor, and continues its progress down till within two inches of the patella, when it is joined by the vastus externus. At its lower part it is joined by the tendon of the rectus, and both muscles form one large one inserted into the rotula.

Upon this muscle are sometimes found two small ones, which arise from the anterior surface of the os femoris, two or three inches above the capsular ligament of the knee joint, into which they are

inserted on each side of the patella. When these muscles are wanting, some of the fibres of the cruræus are spread over the capsula. Where they appear, they are inserted into the capsule on each side the patella, and their action is evidently intended to prevent its being caught. The office of the cruræus is to extend the leg, and to assist the other in doing this.

## DXVI.

*Vastus Externus*

Is a large thick fleshy muscle on the outside of the thigh. It arises by a broad thick tendon from the outer root of the trochanter major. It is continued from the trochanter along the whole outer side of the linea aspera to near the outer condyle of the os femoris, by fleshy fibres which run obliquely forwards to a middle tendon. In the middle of its course it adheres to the anterior surface and outer side of the cruræus, with which it continues to be connected to the lower part of the thigh, where it is seen terminating in a broad tendon which is inserted into the upper part of the patella laterally, and sends off an aponeurosis that adheres to the head of the tibia, and is continued down to the leg. The action of this muscle is to assist in extending the leg.

## DXVII.

*Vastus Internus.*

This muscle is neither so large nor fleshy as the

former. It is situated at the inner side of the thigh, being separated from the last one by the *rectus*. It arises from the fore part of the trochanter minor. It is continued along the whole inside of the *linea aspera*, by fibres running obliquely forwards and downwards, and it is inserted into the upper and inner part of the patella, continuing fleshy lower down than the former muscle; nor does this complete its insertion, it is even in part extended down in an aponeurosis, and fixed to the upper part of the tibia. By this muscle is formed the fleshy cushion that covers the inside of the knee joint. The action of this muscle concurs with the two former in extending the leg, in doing which, the patella is fixed to the tubercle of the tibia by a strong ligament, and supplies the office of a pulley.

## DXVIII.

By these three muscles, also, a large mass of flesh is formed, which incloses all the thigh bone, and they are so connected that the *cruræus* cannot be separated from them. The conjoined power of these muscles cannot fail to be very great; a power increased by the pulley-like advantage of the *rotula*, which extends their action, and fits them for being useful in certain situations; and, by its attachment to the *tibia*, it is rendered capable of sustaining the force of these muscles.

## DXIX.

## FLEXORS OF THE LEG.

*Sartorius.*

The taylor's muscle receives its appellation from bending the knees and drawing the legs across. It is a flat slender muscle, the longest in the body, and from  $1\frac{1}{2}$  inch to 2 inches in breadth. It extends obliquely from the upper and anterior part of the thigh to the upper anterior and inner part of the tibia, being inclosed by a thin membranous sheath. Its origin is from the upper spinous process of the os ilium, by a tendon about  $\frac{1}{2}$  inch in length, and it is inserted into the inner tubercle of the head of the tibia. This muscle serves to bend the leg obliquely inwards, or to roll the thigh outwards, and also to bend the leg upon the knee; all which actions it shews in performing that one which gives it its name. From its distance from the centre of motion, though small, it is naturally a muscle of strong power.

## DXX.

*Gracilis.*

This muscle is named also the rectus internus femoris. It is a small flat muscle, somewhat resembling the former. Its origin is by a short flat tendon near the symphy's pubis, and it passes mediately under the integuments down to the knee. It passes by the inner condyle of the knee

in a round tendinous form, and it is bound by tendon, as it bends behind the head of the tibia. It is inserted with the sartorius into the side of the tuberosity at the top of the tibia. This muscle serves chiefly as a flexor of the leg, and assists the former in making the full flexion of the knee after it has been bent to a certain degree by the flexors on the back part of the thigh. Like the former muscle, by its distance from the centre of motion, its power is very great.

## DXXI.

*Semi-tendinosus*

Is so named from its under half, being composed of small round tendon. It arises from the posterior part of the tuberosity of the os ischium. Its fleshy belly runs down the back part of the thigh, and sends off a long roundish tendon which passes along the inner side of the knee, and ends flat. It is inserted into the inside of the ring of the tibia, a little below the tubercle, and is connected to the under edge of the gracialis. This muscle assists in bending the leg, and at the same time draws it a little inwards.

## DXXII.

*Semi-membranosus*

Has its appellation from its origin, which is from the outer surface of the tuberosity of the ischium by a broad flat tendon. It then grows

fleshy and thick in its middle, and turns thinner again, till it terminates in a short tendon which glides behind the head of the tibia to be inserted there.

This muscle, with the former, composes the hamstrings, by which another motion is acquired when we sit with our knees bent; for, in this position, by means of these muscles, a slight rolling of the tibia is procured, while its chief action is to bend the leg and bring it directly backwards.

### DXXIII.

#### *Popliteus.*

This muscle is named from its situation in the ham. It is of a small triangular form, lying across the back part of the knee joint, very deep under the hamstrings and muscles of the legs. Its origin is by a small round tendon from the outer and under part of the external condyle of the os femoris, and from the back part of the capsular ligament of the joint. In passing the joint it becomes fleshy, spreads out, and its fibres run obliquely inwards and downwards. It is inserted into a ridge at the upper and inner edge of the tibia, a little below its head. By the action of this muscle the leg is bent, and when bent, rolled inwards. It prevents, also, the capsular ligament, by pulling it aside, from being pinched.

## DXXIV.

*Biceps Cruris,*

So named from its two heads, lies in the back part of the leg, running down from the pelvis to the knee, in order to compose the outer hamstrings. It arises by two heads, which afterwards unite to form one muscle. The first, or long head, arises in common with the semi-tendinosus from the upper and back part of the tuberosity of the os ischium. The second, or short head, arises from the linea aspera, a little below the termination of the glutæus maximus, by a fleshy acute beginning, which soon grows broader as it descends to join the first head, a little above the external condyle of the os femoris. The insertion of this muscle surrounds the head of the fibula, and a small portion of it is also implanted into the tibia. This muscle bends the leg, which is the extensive office of its short head, but besides this, its long head is also a muscle of the thigh.

## DXXV.

Having thus demonstrated the muscles of the thigh and leg, we shall next examine the motions performed by them. Thus, if we fix the leg, the muscles that commonly move it act upon the thigh and the trunk, and this is one reason why Nature has not furnished them merely from the thigh bone, but also from the trunk; or, if we act with the longest muscles of the leg, which

come from the trunk of the body on one side, and with those that come from the thigh only of the other, the first are now made muscles of the thigh.

## DXXVI.

The most common office of the muscles described, is walking. Suppose, then, that a person rests equally on both heels, and that he means to make a step forwards, the first thing necessary is to draw the weight of the leg which he intends to move, suppose it the left one. This is done by acting with the muscles of the opposite side, so as to turn the trunk over; and if we throw into action the abdominal muscles, this motion is made. At the same time, we fix the pelvis not only by the weight on that side, but by the abductors of the thigh brought into action, which pull the pelvis over when the thigh is fixed by the weight. Thus the weight is thrown over upon the right leg, and we stand upon it. By standing perpendicular upon the right leg, and the left having a slanting direction, the heel is necessarily raised from the floor, and now fixing the right leg, we begin to raise the left, for which purpose are employed first the flexors of the thigh, the psoas magnus and iliacus internus, which bend the thigh and draw it up; we, at the same time, generally bend the leg a little, and by thus bending the thigh and leg, room is afforded for giving



is the swing forwards. If we are straight upon the right leg, and the other is in the slanting direction, the sole cannot touch the ground; and, in order to do this, we must allow the joints of the right one to bend gently. We now mean to throw the weight forwards, and by degrees to bring it from the right to the left; first, by bending the trunk itself, for which we employ the psoas magnus and iliacus internus as before, but on the right side. These now draw forwards the trunk, as being more moveable, and they support the action of the trunk by the abdominal muscles, while those of the neck bring forwards the head. At the same time we mean to raise the thigh forwards upon the leg, and to push the weight still farther forwards. We employ the extension of the right leg, and as the leg is more fixed than the thigh, the muscles move the thigh and the whole trunk forwards. By these means the weight is thrown more and more forwards, but still not sufficiently, we want still more weight upon the left leg. To this we first employ the gastrocnemii muscles, (not yet described); and, as the legs cannot be bent downwards, the muscles must be shortened, so the heel is raised; and, of course, the tibia, the leg, and the whole body upon it is thrown forwards. As soon as we are sensible that the weight is thrown sufficiently upon the left leg, to fix more than the

trunk, we now begin to employ the muscles of the right leg in pulling it forwards, and the whole of the weight falls perpendicular upon the left leg. To make another step with the right, we do the same thing as before, only we give the leg a greater swing, after which, all the other actions are repeated in the same manner.

## DXXVII.

Running is little more than walking quickly, keeping the legs almost perpendicular to the sockets of the ossa innominata. If we mean to make a more violent exertion of jumping, we bend the joints in order to stretch the muscles, whereby, when we come to throw the energy into them, they make a greater pressure against the several bones and against the earth; and, as the re-action is equal to the pressure, the body is thrown upwards.

## DXXVIII.

*Muscles of the Foot.*

To finish the description of the lower extremities, the muscles of the foot still remain; and these are divided into extensors and flexors.

## DXXIX.

*Gastrocnemius.*

The first of the extensors is the gastrocnemius, which admits a division properly into two parts, and is the great muscle of the brawn.

## DXXXIV.

*Peronæus Longus.*

The peronæus longus arises tendinous and fleshy from the fore part of the head of the fibula, and fleshy from the outer part of the bone to within a hand breadth of the ankle. Its fibres run in a penniform manner towards a long tendon which begins very high about the middle of the leg. It is seen immediately under the teguments as it descends, being that acute line or string, which running down behind the inner ankle, gives shape to that part. At the ankle it passes through a cartilaginous groove in common with the peronæus brevis, being bound down by the annular ligament. When it has reached the os calcis, it quits the tendon of the peronæus brevis, and runs obliquely inwards along a groove in the os cuboides, under the muscles on the sole of the foot, to be inserted into the outside of the posterior extremity of the metatarsal bone of the great toe. This muscle is a powerful extensor of the leg, and gives that obliquity to the foot which gives it figure and utility in walking. It turns down to the ground the inner edge of the foot, by pressing to the ground the great ball of the toe, and is that part which feels sensibly painful on walking. Hence, its offices are to extend the foot a little, to draw it outwards, and to turn the inner edge of it downwards.

## DXXXV.

*Peroneus Brevis*

Differs from the former chiefly in the two circumstances of length and insertion. Its origin is from the edge of the fibula, its fibres continuing to adhere to the lower half of that bone. Its round tendon passes through the groove in the malleolus externus, along with that of the former muscle; after which, it runs in a separate groove to be inserted into the upper and posterior part of the tubercle at the base of the metatarsal bone that supports the little toe. This muscle assists the former in extending the foot, and coincides with it, by turning the outer edge of the foot upwards.

## DXXXVI.

*Tibialis Posterior.*

This penniform muscle is situated behind the tibia and fibula, and between the two last muscles. It arises from the back part and ridge of the tibia, from the opposite part of the fibula, and from the interosseous membrane, continuing its attachment to the latter quite down to the ankle. Its fibres are all oblique, and pass to its middle tendon in the heart of the muscle. This tendon in its <sup>as</sup> descent becomes round, and passes in a groove behind the malleolus internus. It is inserted into the upper and inner part of the os naviculare, and partly into the under surface

of the tarsal bones by separate slips, the last of which goes to the root of the metatarsal bone of the middle toe.

This muscle pulls the foot so as to put the toes together; and, when balanced by the peronæi, it directly bends the foot.

## DXXXVII.

*Tibialis Anticus*

Crosses obliquely the fore part of the leg. It arises from the fore and outside of the tibia, between its tubercle and the articulation of the fibula. It descends on the outside of the tibia, till it reach the under part of the leg, when it sends off a strong round tendon which passes the under part of the annular ligament, near the ankle. It is inserted by tendon into the middle of the cuneiform bone, and the base of the metatarsal bone of the great toe. Its office is to bend the foot by bringing the fore part of it towards the leg.

## DXXXVIII.

## MUSCLES OF THE TOES.

The long muscles of the toes are only four in number, two flexors, and two extensors; and they lie under the last muscle, or keep in their course very near it.

## DXXXIX.

*Flexor Longus Pollicis.*

The first of the flexors arises small and pointed

at its origin from the back part of the fibula, some way below its head. It grows thicker and larger as it descends, and a little above the heel it terminates in a round tendon; which, after passing in a groove formed at the posterior edge of the astragalus, and the internal lateral part of the os calcis, on which it is secured by an annular ligament, goes to be implanted into the last bone of the great toe. The office of this muscle is to bend the great toe, to keep it firm to the ground, and to extend the foot while the heel is raised by the gastrocnemii.

## DXL.

*Flexor Longus Digitorum*

Is situated along the posterior part and inner side of the leg. It arises from the back part of the tibia its whole length to within three inches of the ankle. Its tendon then passes down under a head of annular ligament, and through a sinusity at the inside of the os calcis. It then, soon after, receives a small tendon from the former muscle, and about the middle of the foot divides into four tendons, which pass through the slits of the flexor digitorum brevis, and are inserted into the upper part of the last bone, or third phalanx of the four lesser toes, being inclosed upon the toes by annular ligaments. By the action of this muscle all the joints of the toes are bent, but particularly the last one. The foot is also ex-

tended, and the point of the toes kept to the ground.

## DXLI.

*Plantaris Pedis.*

This is a small body of flesh naturally connected with the last muscle. It arises in two divisions from the lower part of the heel bone, and is pretty nearly of a square form. It joins the tendon of the last muscle before its division for each toe; and, from its long lever upon the heel bone, it must greatly assist the flexor. It is properly a supplementary muscle, and has been variously considered by anatomists.

## DLXII.

*Flexor Brevis.*

The flexor brevis, or perforatus, arises from the under and fore part of the os calcis, and from the aponeurosis plantaris. It soon forms a thick belly, and divides into four portions; each of these portions terminates in a flat tendon, the fibres of which decussate to afford a passage to a tendon of the flexor longus; and afterwards reuniting, they are inserted into the second phalanx of each of the lesser toes. The proper use of this muscle is to bend the first and second joints of the toes, but particularly the second, and the obliquity of the long flexor is balanced by a corresponding obliquity in this short one; while, in

consequence of this obliquity, their power as muscles is increased.

## DXLIII.

*Lumbricales.*

These muscles, in their shape, situation, and number, resemble the lumbricales of the hand. They rise like them in the forks of the extensor tendons, and pass through the digitations of the aponeurosis. They terminate in four slender tendons, which, after running over the inside of the first joint of the four lesser toes, are inserted into the expansion that is formed by the extensor tendons, and covers the upper part of the toes. Their use is evidently to bend the first joint of the toes, and to draw them towards the great one, making an arch over the foot, and thus assisting the transversalis pedis.

## DXLIV.

From the demonstration of the muscles of the foot, we observe that the extensor brevis is situated superficially in the sole; that the plantaris pedis lying deep, arises from the tip of the heel, and is inserted into the flexor longus; that the lumbricales arise from the same muscle where the plantaris ends. Thus the lumbricales are the flexors of the first joint, the flexor brevis of the second, and the flexor longus of the third, or last.



## DXLV.

## EXTENSORS OF THE TOES.

*Extensor Longus Digitorum Pedis.*

This is a muscle of difficult dissection, situated along the anterior and outer part of the tibia, and arising by a thin narrow beginning from the same part of that bone, close to the origin of the peronæus longus, from the interosseous ligament, and from the inner edge of the fibula, to which it continues to adhere its whole length. Many of its fibres are derived also from the adjacent tendinous fascia. It terminates in a long tendon, which passing under the annular ligament of the tarsus, splits into four portions, which are inserted into the root of the first joint of each of the small toes, and expand on their surface to the root of the last. The use of this muscle is to extend the toes; and also, by the expanding of its tendon, to separate them from each other.

## DXLVI.

*Peronæus Tertius.*

This is the name of a muscle situated on the anterior, inferior and outer part of the leg. Its origin is from the middle of the fibula, in common with the extensor longus. It proceeds down to near its inferior extremity, and sends off fleshy fibres forwards to a tendon which passes under the annular ligament. It is inserted

into the root of the metatarsal bone of the little toe. Its use is to assist in bending the foot, and pressing down the edge or the ball of the great toe to the ground.

## DXLVII.

*Extensor Digitorum Brevis.*

This muscle is placed exactly where the buckle lies, having its origin from the heel bone, and running obliquely inwards. It arises from the outer and fore part of the os calcis. It soon forms a fleshy belly, which is divided into four portions that send off an equal number of tendons. These send off an equal number of tendons, which pass over the upper part of the foot, crossing under the tendons of the former muscle, and they are inserted by four slender tendons into the tendinous expansion from the extensor pollicis, which covers the great toe, and into the tendinous expansion from the extensor longus, which covers all the toes but the little one. The action of this muscle is to assist in the extension of the toes, and its obliquity counteracts that of the long one; while, by its expansion, it spreads the toes, and pulls them from the great one.

## DXLVIII.

*Extensor Pollicis Proprius.*

This is a slender muscle that runs from the top of the leg to the second joint of the great toe. It arises from the upper and anterior part of the

fibula, a little below the head of that bone, to the anterior surface of which, and to the interosseous ligament, it adheres for five or six inches. Its fibres run obliquely downwards, and forms a tendon which passes under the annular ligament, from whence it runs obliquely to be inserted into the second joint of the great toe.

## DXLIX.

## MUSCLES OF THE FOOT.

The muscles of the foot are few in number, and much resemble those in the hand.

## DL.

*Abductor Pollicis.*

The origin of this muscle is from the knob of the os calcis, and likewise from the same bone, where it unites with the os naviculare. About the middle of the metatarsal bone it terminates in a tendon; which, after passing over the internal sesamoid bone, is inserted into the root of the first joint of the great toe. The use of this muscle is to pull aside the toe, and give it a little bend. The foot is also curved by it,

## DLI.

*Flexor Brevis Pollicis.*

The situation of this muscle is immediately on the metatarsal bone. Its origin is by a long tendon from the heel bone, and by two separate slips from the os cuneiforme externum. It is in-

separably united with the abductor and adductor pollicis, and it is inserted into the external sesamoid, and the root of the first bone of the great toe. The use of this muscle is to bend the first joint of the great toe.

## DLII.

*Adductor Pollicis*

Is the last portion of the muscle that encircles the great toe. It arises by a long thin tendon from the under part of the os calcis, from the ligament extended betwixt the heel and cuboides, from the external cuneiform, and the root of the metatarsal of the second toe. It is divided into two fleshy heads, which meeting, go obliquely inwards, and are inserted into the sesamoid or first bone of the great toe. The use of this muscle is to pull the great toe towards the rest.

## DLIII.

*Transversalis Pedis.*

This is a small muscle extending across the foot at the head of the metatarsal bones. Its origin is from the ligament which joins the metatarsal bones, and its small muscular belly is inserted into the tendon of the adductor pollicis. By its action, the heads of the metatarsal bones are drawn together, so that it forms a moveable support, for these parts, varying the degree of it according to circumstances.

## DLIV.

*Abductor Minimi Digiti*

Is a long slender muscle on the outside of the foot. It arises from the tuberosity of the heel bone, from the root of the metatarsal bone of the little toe, and also from the aponeurosis plantaris. It runs along the metatarsal bone, and terminates in a tendon to be inserted into the root of the first bone of the toe. By this means its action is the same as the other flexors. It bends the little toe, and carries it outwards; and it extends and supports the tarsus.

## DLV.

*Flexor Brevis Minimi Digiti*

Is a small muscle, resembling the former in place and use. Its length is that of the metatarsal bone of the little toe, from which, or the ligament of the os cuboides, it arises, and is inserted by a short tendon into the root of the first bone of the little toe. Its office is to bend the toe.

## DLVI.

*Interossei.*

These small muscles, from their situation between the metatarsal bones, resemble those of the hand, and are divided like them into the external and internal.

## DLVII.

*Internal.*

The internal ones are three in number, and situated in the plantaris pedis. They arise from the basis and inside of the metatarsal bones, and they terminate in a tendon that runs to the inside of the first joint of these toes, and from thence to their upper surface, where it loses itself in the tendinous expansion from the extensors. Their use is to draw the particular toe into which each of them is inserted towards the great toe.

## DLVIII.

*External.*

The external interossei are four in number, and from their double heads, they have been termed bicipites. They arise from the outside of the root of the metatarsal bone of the fore and great toes; and they are inserted into the inside of the root of the first bone of the fore toe.

The internal interossei occupy the sole of the foot, while the external appear on both sides of the foot. Their office is all to assist in extending the toes.

## DLIX.

*Aponeurosis Plantaris.*

From the great exposure of the palm and sole to injury, besides their muscles, they are defended by a thick tendinous aponeurosis. The plantar aponeurosis arises from that part of the tuberosity

of the os calcis upon which we stand. It is divided into three portions, which run forwards to be connected to the heads of the metatarsal bones of all the toes; and, for that purpose, they expand as they proceed; and their fibres acquire a radiated form. The upper part therefore is thicker, and the under thinner. The middle portion is subdivided again into five slips, which split at the roots of the toes, and embrace the tendons of the flexor muscles.

## DLX.

The uses of this aponeurosis are important. It first protects all the parts that lie under it. It performs the office of a ligament, by binding the two ends of the arch of the foot together. It assists the muscles by confining them in their actions. It also gives origin to several of them, and it forms proper openings or rings for the other tendons to pass through.

## DLXI.

*Chemical Analysis of the Muscles.*

The analysis of the muscles is properly the analysis of the soft parts of the animal structure. For a muscle is a compound matter, and consists of membrane, vessels and nerves, besides the real irritable fibrous structure which constitutes its flesh. When subjected to boiling, this muscular part or flesh resolves into fibrous gluten and ex-

tractive matter. The fibrous gluten, when washed with water, is white, insipid, and elastic, resembling much the gluten of vegetables; and, when heated with nitric acid, gives out azotic gas. When perfectly boiled, it is without smell, taste, or colour. The extractive matter, again, is the proper juice of the flesh, and gives colour, smell, and taste to the fluid. It also forms a brown crust on the surface of roasted meat, which gives to it the agreeable taste and smell of burnt sugar. The phosphorated calx and soda, are the salts contained in it.

#### DLXII.

The constituent parts of these two principles, are animal jelly and gluten.

Animal jelly is an elastic juice, soluble in water, and filling up all the interstices in the soft and hard parts. In the fluid state it forms broth, and in the dry state glue.

#### DLXIII.

This substance possesses no taste; it is soft and insipid, and of a whitish colour. By cold, its consistence is a thick transparent tremulous mass, which attracts moisture from the atmosphere, and passes by stagnation and heat into the acetous and putrid fermentation. On farther examination, its constituent principles appear to be

1. Water in a large proportion, so that from 20 oz. of jelly, 18 of water are obtained.



2. Sugar, for dried jelly, heated with nitrous acid, gives out the saccharine and malic acid.

3. Gelatinous gluten, for it disengages azote by mixture with the acid of nitre; and, by dry distillation, it yields the products of animal gluten.

4. Sea salt and phosphorated calx; these principles being left in its carbone.

## DLXIV.

This matter, thus examined, constitutes the nutritious juice of the animal body, and is supplied for the growth and repair of the soft parts to which it is every where carried by minute arteries along with the blood, and deposited in the interstices of the fibres which constitute the parenchyma proper to any part. Its circulation is constant and slow, as the use of madder to animals demonstrates.

## DLXV.

The next principle of which the muscular substance is composed, is animal gluten, an elastic juice, insoluble in water; and this gluten is conspicuous after the jelly is extracted in the form of a white tenacious mass. This mass has neither taste nor smell; and, when dried in the air, changes into a horny substance, becoming black by combustion, and diffusing the fœtor of burnt hartshorn. Exposed to moisture it soon acquires putrefaction.

## DLXVI.

The elementary parts of which this gluten are composed.

1. A small portion of water, as displayed by distillation.

2. Carbone, from the blackness acquired by burning.

3. Azote, which boiling with the acid of nitre, shews to pass off in great quantity; and

4. A small quantity of animal earth and phosphorated calx.

## DLXVII.

## JOINTS.

Thus have we traced, at considerable length, first, the bones or basis of the body; and next, on removing the common teguments and intervening substance, the muscles or powers by which these bones are moved. Before proceeding farther, it is proper to complete this division of the subject, by pursuing a detail of the particular structure where the bones are joined and the muscles fixed, with a view to facilitate the action of the latter, and to enable motion to take place in the former. This division is distinguished by the name of joints.

## DLXVIII.

The constituent parts of the joints, we find, vary according to their particular functions; but every joint consists of cellular substance and its two

modifications of ligament and tendon in various forms and proportions.

## DLXIX.

The cellular substance we have already seen in a variety of situations; first, as a part of the teguments or universal covering of the body, containing the fatty cells, or being the seat of that fluid which makes the motions of every part easy and free, filling up the interstices of the muscles, and supporting their fibres at a great distance from each other.

2. This substance has been presented to us in a still more condensed form when enclosing an individual muscle in the manner of a sheath, with a view to give form and shape to the part it covers, or to preserve it in its proper situation; and the condensation of this sheath still increases farther with action of the part and with years.

3. To accommodate still more the shape of parts, and preserve at the same time a proper power of the muscle, a farther condensation of this substance is made by forming it into a white cord named tendon, and this white cord forms the means of its insertion into bone. That this tendon is of a different nature from the muscle itself is clear, from its easy separation from parts, and its want of sensibility, the reverse of both which is conspicuous in the muscle.

4. The connection between periosteum and tendon is also proved by their intermixture with each other. They are the same matter, only differently modified from the different situations in which they are placed.

5. To increase still more the power of tendons, another modification is added to assist it, or a sheath to prevent the muscle starting from its place; and this sheath either forms an envelopment of the muscle, or makes a band, tying it down in certain parts, by all which, the muscular power is considerably increased.

6. This cellular membrane is next found in the form of bags, surrounding the joints, leaving the thin texture it possesses in covering the bones to be converted into a strong hard bag, binding the bones together, and forming the capsule of the joint, which is farther strengthened by the tendons, and occasionally also by other ligaments formed out of the same substance.

## DLXX.

Thus the cellular membrane covers the bones, forms the connecting medium of the joints, is the expansion of the muscles in the form of tendon and fascia, and assumes different appearances to complete the structure of the joints, as in that of bursa, ligament, &c. In all these forms it is a part naturally possessed of little sensibility, slow in taking on increased action, but displaying a sense

of feeling, and acquiring a degree of inflammation when excited more permanent and violent, than in parts of a more nervous and irritable structure.

## DLXXI.

With these general observations, we enter upon the structure of joints; and each joint we find is composed of the heads of the bones swelling out at the part where they form this division of structure into a broader articulating surface than in the rest of their course, and next of a thin plate of cartilage in order to defend the surfaces of the two bones. Sometimes these cartilages are moveable, and roll upon the bones so as to yield to all the motions of the joint, and prevent any hurtful consequences. The third part is glands or bags, to convey a lubricating mucus fluid. The fourth is a burfal ligament, inclosing the whole joint, and composing its purse, within which is contained the synovia, and by which the surrounding parts are prevented from being caught in the joint. The fifth part is small ligaments, going along the sides of the joints on the outside of the capsule, and passing from one joint to another; and the sixth part is tendons moving over the joint, and accompanied with burfæ to prevent that injury their constant friction might occasion.

## DLXXII.

Such are the general parts of every joint, and we next shall examine the structure of the different individual joints.

## DLXXIII.

*Joints of the Head and Back.*

The joints of the head consist in the manner of its connection with the two first vertebræ. That connection was formerly explained, so that its junction with the atlas enables it to perform all the nodding motions, and the junction of the atlas with the dentatus gives it the turning motions. These connections the head thus possesses, are secured by regular capsules and ligaments. The first is a flat membranous ligament, extending from the ring of the atlas to the ring of the occipital hole, and thus closing the interstice between the occiput and first vertebra. The atlas again is tied to the dentatus by several ligaments.

## DLXXIV.

The first is the regular capsules, fixing one vertebra to another. 2. The second is a cross ligament, which, after crossing the ring of the first vertebra, embraces the tooth-like process, and ties it down. 3. The third is a smooth cartilaginous surface round the root of the tooth-like process, to enable it to turn with ease. 4. The fourth is a ligament, tying the threaded extremity of the tooth-

like process to the occipital bone. The whole of these parts are included in a regular capsule like any other joint.

## DLXXV.

The connections of the other parts of the spine are more complicated. Each vertebra is united to the one above and below. 1. By its intervertebral substance. 2. By their articulating processes to each other. 3. By the cross or intervertebral ligaments securing the intervertebral substance, and which go from the edge of one vertebra to the edge of another. 4. By the general external vaginal sheath of the spine, which goes over the fore part of all the vertebræ from top to bottom, being at first pointed and small, expanding as it descends, strongest in the back where there is least motion, and weaker in the neck and joints. 5. By internal ligaments of various kinds passing between the vertebræ, and securing them to each other. 6. By the internal ligament or sheath of the medullary canal; and 7. By the internal ligament belonging to the neck alone.

## DLXXVI.

*Joint of the Lower Jaw.*

The lower jaw, by its articulations, is a simple hinge, the joint of which is formed by a deep hollow in the temporal bones, by a ridge at the root of the zygomatic process, and by a head or condyle; all which parts are covered with a plate

of cartilage. A capsule of the common form is thrown over the joint arising from the neck of the condyle, and fixed into the temporal bone, by which the socket and root of the zygomatic process are included. In the action of the jaw, the effect of these different parts is, that in its motions the transverse ridge is required; that the usual small motions are performed by the condyle, moving in the deep socket or hollow; that in the more extended motions or wide openings of the mouth, the condyle mounts by the depression of the jaw upon the root of the zygomatic process. To facilitate the motions of this joint, there is interposed a moveable cartilage, thin in its centre, and thicker towards its edges, by which it rather deepens than fills up the hollow of the joint, and this cartilage corresponds in shape with the condyle and socket of the temporal bone. To secure the joint, it is strengthened by its muscles, the insertion of which is close round it.

## DLXXVII.

*Joints of the Ribs.*

The ribs possess two motions, alternately rising and falling; and the joint admitting this motion, is formed by a regular capsule covering the head of the rib hinged on the intervertebral substance, by touching each of the vertebræ between which it is placed. This capsule is regular and lubricated within, without it has a radiated form, ex-



panding pretty broad on the sides of the vertebræ. The fore part of the transverse process touches the back part of the rib, and is articulated there by means of a capsular ligament. It is farther secured by two ligaments taking hold of the neck of the rib from the transverse process of the vertebra, and other smaller ones from different points assist for the same purpose.

## DLXXVIII.

To the sternum, the ribs are joined again by cartilages, and these possess the parts of a joint by having a round head, a distinct socket, a proper capsule and ligaments, which are expanded on the sternum. These cartilages are also bound to each other by a tendinous membrane that spreads over and also covers the intercostal muscles, with a fascia, taking its origin from different parts.

## DLXXIX.

*Joints of the Upper Extremity.*

The junction of the clavicle and sternum, is the hinge of the upper extremity, or is the point by which it is connected to the trunk, and on which it is moved, the round head of the clavicle being rolled upon the articulating surface of the upper bone of the sternum. This articulating surface is composed of a small moving cartilage which rolls betwixt the head and the sternum, being thin and mucous. The whole is then in-

## AND DISSECTION. ccccxxvii

closed in a strong capsule formed of a bag and outer order of fibres, which radiate on the surface of the sternum, or cross and meet, so that by their union from the opposite sides, a cord is made across, named the interclavicular ligament. Thus is the clavicle and sternum joined, while a broad ligament ties it to the first rib. To the scapula it is connected by touching the edges of the acromion process, with a narrow flat articulating surface, tipped with cartilage, and the joint is then secured by a thin delicate capsular ligament strengthened farther by different ligamentous bands passing over betwixt the clavicle and the acromion process. As it passes over the point of the coracoid process, a ligament of great strength ties it down, being inserted into the inner edge of the clavicle. Other ligaments also pass from one process of the scapula to another peculiar to that bone.

### DLXXX.

#### *Shoulder Joint.*

The shoulder possesses a loose moveable joint, formed by the large round head of the humerus received into the cavity of the scapula. This oval cavity is small and shallow, and to lengthen it it possesses a cartilaginous border, but still of a size insufficient for lodging the head of the bone, which is rather laid upon it than sunk within it. It has also a loose wide capsule arising from the

## cccxxxviii DEMONSTRATION

edges of the glenoid cavity, and inserted round the neck of the bone. A large secretion takes place in the joint, partly of mucus, and partly of a serous fluid, from the termination of small arteries. From this structure the shoulder joint is loose and free, but proportionally weak. Still, however, it is guarded by large projecting processes by the acromion above, and by the coracoid process within; between which, a ligament extends, securing its defence above and on its inner side. Besides this, it is powerfully secured by the insertion of the four muscles which arise from the scapula, close round the head of the bone. By their adhesion to the capsular ligament, they render its motions free, strengthen it, and preserve it in its place; and the joint being surrounded with numbers of mucous bags or bursæ, which open into it, every means of obviating any hurtful consequences from friction are guarded against.

### DLXXXI.

#### *Elbow Joint.*

The elbow joint is more complex than the former one, and is composed of three bones, the humerus, radius, and ulna, which form one joint, inclosed in a capsule, arising from the humerus and all round the processes which receive the olecranon and coronoid processes of the ulna. It is inserted into the tip of the olecranon round

## AND DISSECTION. cccxix

the cavity, receiving the lower end of the humerus, and round the edge of the coronary process, being connected likewise to the neck of the radius. A supply of mucus and fat is added to lubricate the joint, and it is secured by ligaments on the outside of the capsule, strengthening its different points.

### DLXXXII.

Thus the elbow joint is composed of a capsule inclosing all the bones, of ligaments in various directions to keep it firm and regulate its motions, and of cellular substance, muscles, and tendons. Its strongest parts are its sides, for it is equally weak both behind and before.

### DLXXXIII.

#### *Wrist Joint.*

The wrist is a joint of more extensive motion than the former, and it unites the strength of the hinge with the rolling motion of the ball and socket. From this circumstance, it is to be considered in two points of view.

### DLXXXIV.

Thus the articulation formed by the scaphoid and lunated bones, composes an oval ball received by the great scaphoid cavity of the radius, and over it a general bag or capsule is thrown. This capsule arises from the ends of the radius and ulna, from the styloid point of the one to the same point of the other, and is implanted near

the lower rank of the carpal bones. In this way it proves on one side an additional ligament to the carpus; and, on the other side, as the tendons of the fingers run over it, it forms a lubricating surface for their sheath. Besides this, particular ligaments also arise from the different processes of the radius and ulna; and one internal ligament is noticed of a soft pulpy nature, which serves at the same time as a conductor for the lacunæ, which separate the mucus.

#### DLXXXV.

The articulation of the radius with the ulna, enables the hand to perform all its turning motions. The lateral cavity of the radius receives the head of the ulna, and they are inclosed in a peculiar loose capsule, so that one joint is within another, divided by a moveable cartilage.

The carpal bones display so close a connection, as hardly to form a joint; and each bone has four smooth surfaces uniting it to the adjoining bones. The great ball of the wrist is composed of the first two bones; a ball and socket unites this row to the first, and a distinct and general capsule is the means of this; besides which, each single bone is tied to the next adjoining one by a regular capsular ligament within, and by flat cross ligaments without; which, from their various convolutions, exhibit a radiated form.

The metacarpal bones are joined in the same manner to the carpal by joints, forming as it were one, and over which a common capsule is expanded; besides this, each bone has its peculiar ligaments, proceeding radiated from the carpal bones, and spreading out upon the metacarpal, so that the carpus and metacarpus are securely connected; and where, again, the metacarpal bones are implanted into the fingers, they are also bound by flat ligaments, uniting them to each other, and which allow such a bending as is necessary to form the hollow of the hand.

## DLXXXVI.

*Joints of the Fingers.*

The joints of the fingers form something of a ball and socket, and are only restricted in their motions by their ligaments, which make them a hinge joint; for each joint is first inclosed in a capsule, and then secured by lateral ligaments on its sides, to which its strength is owing. These ligaments, again, are farther strengthened by the faciae of the interossei muscles, which expand over the back of the fingers. A part of the joint, also, at the wrist, is the smooth sheath in which the tendons of the fingers move. The outer side of the capsule of the wrist composes it in part, and the ligament proceeding from the four corner points of the carpal bones. This sheath is lined with a delicate mucous membrane, resembling in

its discharge a bursa mucosa. This membrane, also, being divided into partitions between each flexor tendon, possesses a separate bursa mucosa to each; and, by this means, the hurtful consequences of friction in these parts is particularly guarded against. The sheaths of the tendons, in their course to the fingers, all form bursæ; and thus they form both the office of a ligament by binding down the parts, and also of bursæ from the lubricity of their internal surface. These sheaths vary in their thickness in certain points, but still they form one common canal, termed the annular ligaments of the fingers, and in their offices they resemble the offices of the bursæ, none of which exist in the fingers.

## DLXXXVII.

## JOINTS OF THE LOWER EXTREMITIES.

*Thigh Joint.*

The socket, or acetabulum of the thigh bone, is lined with a thick smooth cartilage, and the head of the bone is also covered with the same, and these cartilages fill part of its cavity, and smooth the junction of the different pieces of which it is composed. The socket, besides its cavity, is deepened by the cartilage which tips its edge, and which also rises upwards. At the side towards the thyroid hole, the bony cavity of the socket is imperfect, and the deficient space is filled up by a strong ligament going across the opening from

• one point to the other. Of all the capsules, that of the hip joint is the thickest and strongest, and it embraces extensively every part, as well the neck as the head of the bone. Besides this general capsule, there are also two internal ligaments. The first arises from the centre of the socket, and is fixed into the centre of the ball of the thigh bone, being somewhat flat and triangular. It is broad when it arises from the bottom of the socket, is about  $1\frac{1}{2}$  inch in length, narrow as it proceeds outwards towards the head of the bone, and round where it is inserted into the dimpled head of the thigh bone. Round the roots of this ligament, in the bottom of the socket, there is left a deep hollow filled with the synovial gland, or rather a ragged mass, from the ducts of which mucus is pressed, and by this structure there is less danger of injury from pressure than if it had been an actual gland. A quantity of fat accompanies this structure, and a soft mucous membrane by which the ragged mass is tied and preserved in its place, so as to move with the motions of the joint.

This ragged mass has two or three small bridges in different directions, named its mucous ligaments, and which are properly an inflection of the internal lamella of the capsule lining the socket, and reflected over every part of the joint. Besides this ragged mass described, others of the



same nature lie at the lower part of the joint or round the neck of the thigh bone, and serve by their excretion to lubricate and moisten the joint.

To strengthen the capsule of this joint, although the thickest in the body, many additions are made to it. It receives a ligamentous slip from the lower spinous process of the ilium, spreading out upon it, and strengthening its fore part. The smallest of the glutæi muscles strengthens it behind. The psoas magnus and iliacus internus advance along its inner side, and the tendon of the rectus lies upon its outer side. Thus it possesses many additional securities, though the strength of its own capsule is chiefly relied on.

### DLXXXVIII.

#### *Knee Joint.*

This is a joint the weakest of itself, or in its own structure as a joint, in the body, but it owes its strength to the number and disposition of the ligaments by which its bones are joined, which render it the strongest and most serviceable of the whole, while the complication of structure which gives it strength, occasions it in the same degree to be more liable than any of the others to disease.

### DLXXXIX.

The bones of this joint are the tibia, thigh bone, and patella, which are thus united:

1. A thin capsule proceeds from the fore part

of the thigh bone all round the articulating surfaces, and passes by the sides of the condyles, being inserted into all the edge of the rotula, and keeping it without the cavity of the joint. Below, it is fixed into all the circles of the head of the tibia, and thus it embraces all the bones. From the surrounding parts it receives next considerable thickness. Behind, being covered by the heads of the gastrocnemii, by the biceps, and other muscles of the hamstrings at the sides; while, by the several fascia of the thigh, it is strengthened before, and receives also the additional expansion of several muscles, which go out over the patella. In addition to this, on the back part, it possesses also a ligament arising from the outer condyle, and passing obliquely across, which adheres to it, and secures the knee behind, serving as a check to it, in order to prevent its yielding too far: though this ligament is sometimes wanting.

2. Strong lateral ligaments connect the pieces of this joint. The 1<sup>st</sup> of these, broad and flat, comes down from the internal condyle of the thigh bone upon the inner side of the joint, and is fixed into the inner seat of the tibia, being named the internal lateral ligament. The 2<sup>d</sup> ligament, round and stronger than the former, descends for the length of two or three inches from the tip of the outer condyle on the outside

of the knee to the bump of the fibula, which it embraces; and the 3<sup>d</sup> arises, like the first, from the internal condyle of the thigh bone, appearing merely in a scattered form, as strengthening the capsule, and being inserted into the knob of the fibula.

3. The internal ligaments also secure the union of the knee bones. These are termed the crucial ligaments, and are seated within the cavity of the joint. Their origin is betwixt the condyles of the thigh bone; and they are inserted into the back part of the middle rising of the tibia, lying flat upon the back of the capsule, and crossing each other, so as to receive the distinction of anterior and posterior crucial ligaments. Their effect is very particular. When the knee is bended; the posterior ligament is extended; when the leg is stretched out, the anterior ligament is extended; so that they are both checks upon the motions of the joint, the anterior one preventing the leg going too far forwards, and the posterior one preventing its being too much bent back upon the thigh.

4. The two semilunar cartilages are the next part in investigating the structure of the knee, so named from their form, and lying on the top of the tibia, so as to fill up the hollow of the bone. In their form, they are thick towards their convex, and thin towards their concave edges, ending by

two acute long horns, named their cornua, which are tied to the ridge in the middle of the articulation of the tibia; and, being turned towards each other, they touch in their points.

In this joint there are also fatty masses which inclose the fimbriated ends of mucous ducts, and these masses are chiefly conspicuous round the circumference of the patella. They appear also about the crucial ligaments, and in all the interstices of the joints, protecting the mucous ducts, and adding to the general secretion.

#### DXC.

The inner surface of the capsule, on which these masses lie, is much larger than the joint it lines, and therefore it forms various folds, distinguished by particular names. At each side of the patella there are two, termed the ligamentum alare majus and minus, which join in one middle fold, running across the centre of the joint, and named, from its keeping the fatty bundles in their place, ligamentum mucosum. This internal membrane covers also the femilunar ligaments, and at their horns forms four small ones, two for the horns of each cartilage, named the ligaments or adhesions of the lunated cartilages. Besides which, there is a small slip that goes round upon the fore part of the tibia, and ties the fore part of the cartilages to each other, named the

ligamentum transversale commune. The cartilages also adhere to their outer circle or thick edge, and to the surface of the capsule internally.

## DXCI.

In respect to a structure for lubricating it, the knee joint possesses larger *bursæ mucosæ* than any other. There is one above the patella, among the extensor muscles, three inches in length. There is another below the patella, and under the ligament, smaller. They are of the same substance as the capsule, and are united to it by cellular substance.

## DXCII.

Thus the knee joint is rendered strong by the variety of substance thrown over it to connect its parts, and by the provisions also made for its easy motion. It possesses a capsule inclosing all its bones. It possesses additions to this capsule, in order to give it strength and thickness from the common fascia and particular expansions of the muscles. It is secured on its sides by the lateral, and behind by the posterior ligament. Internally, it is fixed by the same substance. To facilitate its motions, it is provided with moveable cartilages of the most perfect form and use, and to these are added the structure for the secretion of mucus, and the fatty masses which keep it moistened with a constant secretion.

## DXCIII.

*Fibula.*

The fibula does not deserve notice as a joint. It is merely a support to the tibia, but it gives adhesion to muscles, and is the main defence of the ankle joint. It is merely laid upon the tibia, not sunk into it, and united by a flat cartilaginous surface. It is tied by a close capsule, and strengthened by the external lateral ligament of the knee and the insertion of the biceps tendon, both being implanted into its knob. A farther security it acquires from the great interosseous ligament passing from bone to bone.

## DXCIV.

*Ankle Joint.*

The ankle joint acquires its security from the particular form of its bones. The lower heads of the tibia and fibula are so secured to the foot, by forming a cavity for the astragalus, that nothing but fracture can displace them; and they are also farther strengthened by particular ligaments, one of which passing from the tibia to the fibula on the fore part, is named *ligamentum superius anticum*, being composed of one and sometimes two flat bands. Another broader ligament passes in the same way along the back part, and is termed *ligamentum posticum superius*, and a slip of it is named *ligamentum posticum*

*inferius*. The capsule then unites the different bones, joining the astragalus to the tibia and fibula. It is thin, but strengthened by a variety of ligaments both behind and at its sides. The first is a strong triangular formed ligament, descends from the acute point of the inner ankle, expands radiated upon the capsule, and is fixed along the sides of the astragalus. In the outer ankle there are three ligaments, one proceeding forwards, one backwards, and one directly downwards. The first is named *ligamentum fibulae anterius*, from its proceeding from the knob of the fibula obliquely downwards and forwards, to be fixed to the side of the astragalus. The second is termed *ligamentum fibulae perpendiculare*, from advancing straight down from the acute point of the outer ankle, to be inserted into the heel bone. The third arises from the same point as the former, and goes backwards over that part of the capsule, being named *ligamentum inter fibulam et astragalum posterius*.

## DXCV.

To this structure of the ankle joint, little farther is to be added. It is covered with cartilages, lined with a mucous membrane, and lubricated with fat and mucous fimbriae. It is the strongest of the joints, and requires more violence than the others to injure it.

## DXCVI.

The bones of the tarsus are united to each other by their large heads, and also by distinct joints. They are also cross tied to each other by ligaments passing in every direction, and very numerous. They are so complicated as to form a sort of web on either side of the foot. Each bone has its capsular ligament for joining it to the next. Each joint also of each bone has its articulating cartilages. Over the more important bones, separate ligaments are also thrown, so as to produce the greatest security and strength in the motions of this part.

## DXCVII.

The metatarsal bones also have their capsular ligaments, which unite them to the tarsal bones. Additional ligaments strengthen these capsules, and tie them more strongly to the tarsus, and cross ligaments tie the several ranks to each other both in the upper and under part of the foot, passing from the root of one bone to the root of another. The same structure prevails here as prevails in the fingers.

## DXCVIII.

To support and secure the whole arch of the foot, as well as these separate parts, one great ligament remains to be noticed. It extends in one triangular flat plate from the point of the heel



to the roots of each toe, being named the aponeurosis plantaris. It passes from point to point like a bow string. It arises from the heel on one point, expands in the same proportion as the sole of the foot, turns broad, and is divided into three narrow heads, to be inserted into the roots of so many toes.

## DXCIX.

In the ankle and foot, the bursæ mucosæ are extremely narrow, but have no direct communication with the joint. They accompany the long tendons as they pass behind the ankle or in the sole of the foot. They run also along the flat face of the toes.

## DC.

Such is the different forms or variety of the human joints, which it has been common to arrange into different classes. Pursuing this method, we observe,

1. In tracing the bones, many examples occur, particularly in the head, where the number of pieces is considerably greater than the number of motions intended; or, where the bones are connected by a number of teeth, which gives an appearance compared to a suture, and this obtains not only in the cranium but in the face.

In the jaws we perceive a connection of the teeth made in a very different manner; they are sunk into the jaws, and adhere to them as a nail

adheres to a board; so, to use a general term, we would say the bones are applied to each other, for we may overlook the membranes which are almost obliterated, or very thin, and still the parts from their shape cohere, we might therefore call this synostosis, to keep up a general analogy.

2. With regard to the number of different articulations in the trunk chiefly, we have seen that wherever a motion is intended; but where the danger of separation is considerable, or where even extent of motion is dangerous, there is interposed a cartilage, or this with a mixture of ligament, and this has been named synchondrosis: but with regard to that kind of articulation, the cartilage is seldom found pure, even the joining of the ribs to the sternum has a kind of articulation, as elsewhere.

A third kind of articulation is the syndesmosis, from the connection being by ligaments, while the bones themselves have no immediate adhesion, but are tipped with cartilage, and tied together with ligaments. This obtains particularly in the extremities of the body, and it is of three kinds.

A. Where there is a free motion in all directions; and this is made by a ball and socket, which is most remarkable at the joining of the two extremities to the trunk of the body: but we find several instances of the same in the lesser joints.

B. Next, in a number of places, we have

found a motion in a certain degree in all directions, but very limited; or, where the surface of the bones were almost flat, and the ligaments very short, particularly in the joining of the tarsal and carpal bones with those of the hand. The third kind is the

C. Hinge, which is of three species.

a. The connection of the head to the spine, turning upon a centre pin; and we have no instance of the same kind in the other parts. But the most common species is

b. Where one or more bones are included in one capsular ligament, as the joining of the humerus with the fore arm, and where the shape of the bones and length of the ligament regulate the motion to two directions, the ligaments at the side preventing the lateral motion, and even the bare bones not readily performing a lateral motion. And we should reckon a third kind

c. Where two move upon each other in different places, and with two joints, yet we consider them as one. Thus the back part of all our vertebræ have a pair of oblique processes, which are intended for one motion. In like manner the ribs are not only connected to the vertebræ by a round ball, but likewise to the transverse processes, and thus too the radius is connected to the ulna which conspire to accomplish one general motion, as in like manner do the tibia and fibula.

Now every one of the joints of the body can be reduced under one or other of these articulations. For the *symplicosis* is only to be found in quadrupeds, and the scapula and clavicle are connected in the usual way to the bones of the body.

## DCI.

## BURSÆ MUCOSÆ.

In examining the joints, we have taken notice of a particular structure, the *bursæ mucosæ*. The membrane of these cavities within is very smooth, and a quantity of fat is found constantly on the outer side. In several of the *bursæ*, the fat is even seen projecting into them, and upon the inner side there is found a slippery liquor which is often collected in considerable quantity, as in the bursa behind the tendo achillis. This liquor does not coagulate in a burning heat, and very much resembles the saliva; but, it has a quantity of oil very intimately mixt with it, and the liquor of the *bursæ* may be compared to the liquor found within the articulations. There is an analogy between the capsular ligaments and these *bursæ*, and there frequently appears a communication between the large *bursæ* at the knee, and the cavity of that joint. It is of particular use in practice to be acquainted with all the sheaths of the tendons of both extremities, for within every sheath there is a fine bursa running a very

considerable way; and, where a number of tendons enter at one common place, as at the wrist, we find the tendons dividing, and a bursa produced under each, which is frequently the seat of disease by becoming enlarged in size, and filled with a viscid glairy matter.

## DXCII.

The chief seat then of the burse is the extremities and between tendons and bones, where they play upon each other, as at the insertion of the biceps flexor cubiti.

Or, where tendons rub on each other, as between those of the extensores carpi radiales and extensores pollicis.

Or, between tendons and the external parts, as in the sheaths of the tendons of the flexors of the fingers and toes, where they furnish a lining to the sheaths, without communicating with other parts.

Or, between tendons and ligaments of the joints as between the tendons of the flexors of the fingers, and capsular ligament of the wrist.

They are found in a few places, where processes play upon ligaments as between the acromion and capsular ligament of the humerus.

Or, where bones play on each other, as between the clavicle and coracoid process of the scapula.

Some of the bursæ of contiguous tendons communicate with each other, as between the extensor carpi radialis, and extensor secundi internodii pollicis.

Others communicate, not only in adults, but often also in children, with the cavity of the joints, as behind the tendon of the extensors of the leg, though this is more frequently the case in advanced age.

### DXCIII.

The general structure of these bursæ is the same with the inner capsule of the joint. They are formed, as we observed, of a thin pellucid membrane, possessed of little feeling, and joined to the surrounding parts by cellular substance, and in many by a covering of fat. They commonly possess also a thin layer of cartilage, or of tough membrane between them and the bone. Masses of fat project also into their cavities, having a fimbriated edge, and they are lubricated by the same gelatinous secretion as takes place in the joints. Thus, to lessen friction, is the sole intention of their structure, and only where the parts are exposed to this, in consequence of their action, are the bursæ to be looked for.

### DXCIV.

From this general description of these bursæ, and their use, their situation in the different parts of the body must be apparent without entering

into any special detail, which some authors have reckoned necessary. In all tumors of the joints, their situation with respect to the *burfæ mucosæ* requires particular attention, in order that we may be able to ascertain exactly their nature, and form a prognosis from this circumstance of their degree of danger.

## DXCV.

*Chemical Analysis of the Joints.*

1. Membrane, which is the basis of the cellular substance of ligament, tendon, and cartilage, is little else than gelatin. If any of these substances be boiled in water, it is nearly entirely dissolved; and, when cool, the solution is gelatinous. Cellular fibre, therefore, is considered as gelatin, rendered concrete by a degree of oxydation; and ligaments, tendons, and cartilages, differ only in containing a greater proportion of phosphate of lime.

2. As well as the solids, the fluids of the joints, or synovia, deserve to be analysed. The situation of this fluid was already noticed in the demonstration of these parts. This secretion possesses a fatuous animal smell, and a saltish taste. It is of a viscous consistence, and of a greenish white colour. It exists in various quantities in the different joints, but is most abundant in the joints of the femur and knee.

3. The constituent principles of the synovia are water, lymph, an albuminous principle, muriate of soda, carbonate of soda, and phosphate of lime, but this last in very small proportion.

4. The fluid of the *bursæ mucosæ* or tendinous sheaths, appears of an oily mucous nature, and it is collected in cases of disease or ganglion in great quantity, in the form of allumen.

## DXCVI.

## VASCULAR SYSTEM.

*Heart.*

In examining the muscles, their red appearance we find the consequence of a coloured fluid pervading their fibres, and confined within certain tubes or vessels distributed through every part of them. The origin of these vessels, when traced farther, appears to be in a large organ, the heart; and this organ is placed in the middle of the body, and is the centre of the vascular system. The vessels on which this organ more immediately acts, are the arteries and veins. By the former, the blood is distributed over the body with force and pulsation; by the latter, it is returned in a slow and languid stream back to the organ from which it was discharged. The situation of the organ is between these two sets of vessels receiving the blood by the veins into its cavity, and expelling it again from it with strong contraction by the arteries. Nor is this all, for, besides the simple expulsion of the blood by its peculiar form of organization, it distributes it through the lungs, so that the fluid may be purified or oxydated in that organ, and conveyed to the body in a fit state for performing its functions.



## DXCVII.

From these different offices, the heart possesses a two fold structure, as formerly noticed in a general way, (XV.) or a heart fitted for the circulation of the lungs, and a heart fitted for the circulation of the body; and the propriety of this distribution is evinced by the difference of structure in this organ, between animals that breathe, and animals that do not. In the animals that do not breathe, the heart is single, or consists of an auricle and ventricle, with an artery and vein. In the animals that breathe, this structure is double. The right side is appropriated to regulate the circulation of the lungs; the left side, to perform the distribution through the body.

## DXCVIII.

With this general idea in view, we descend to the particular structure of the organ.

1. The first part of it to be demonstrated is the two *venæ cavæ*, so named from their size, the one bringing the blood from the upper, and the other from the lower parts of the body, the former named the *cava descendens*, and the latter the *cava ascendens*. Previous to their forming one trunk, they receive the collected large veins of different parts of the body, the descendens being joined by the right jugular and right axillary vein, and by the great branch containing both the veins of the left side, the ascendens being in like

manner joined by the cava abdominalis and hepatica; and both the cavas unite together in the end, to form the right sinus of the heart.

2. This sinus is merely the dilatation of the two veins, forming a reservoir for the constant supply of the organ. As the veins approach this part, their strength is increased; and as the sinus approaches the auricle, it becomes stronger also in the same proportion. In strength, the auricle and ventricle are pretty uniform, and their strength is increased by the various crossings of muscular fibres, and by deep risings and furrows upon the inner part.

3. The angle of the two veins has been termed the tuberculum loweri, and which being cushioned up also on the outside by fat, has been noticed as a remarkable part by most anatomists.

4. The auricle, so termed from its resemblance to a dog's ear, is an appendage to the sinus, being small, semicircular, and notched; and it is the extremity of the sinus on the one hand, while the veins are on the other. In the auricle, the muscular fibres display strong deep furrows that cross each other, and are named the muscoli pectinati, resembling in their appearance the teeth of a comb, while the texture of the auricle itself is beautiful and transparent.

5. The valves of the auricle are placed between it and the ventricle, and they serve to regulate the

movements of the heart. Thus, as the cavae pour in the blood upon the sinus and auricle, and the auricle pushes it on to the ventricle, the valves prevent its return from the latter till it is enabled to act and expel it. That they are fitted to do this is evident, for the tendinous circle or hole between the auricle and ventricle is covered with a thin membrane hanging down into the ventricle, which grows gradually thinner and divides into fringes. These fringes are tied to the inside of the ventricle like tendinous cords, which they are named, and are attached to processes projecting from the muscular part of the heart. Of these attachments, there are three points dividing the circle into three acute pointed valves, named *valvulae tricuspidæ*. All these parts cross each other; and, by this crossing of their tendons the valves fall down when the blood passes through them, and they rise when it gets behind them.

6. The ventricle of the right side, like the auricle, is larger than that of the left, being, as formerly explained; the heart of the body, and it is therefore more subject to occasional turgescence than the other. This ventricle is thick and fleshy, and very irregular on its inner surface, in every part of which it puts out strong fleshy columns. The size and course of these columns also vary, some running length and others cross ways, so that its opposite sides are connected together, and

they form a set of strong fleshy muscles. In the interstices of these columns are deep and irregular grooves, where the blood coagulating, forms polypi after death. Besides its difference of strength, and also larger cavity, the right ventricle differs from the left in the peculiar partition or septum cordis belonging to the left one.

By the situation of the right ventricle, it is wrapt as it were round the left one, and the latter forms the acute apex of the heart, and bulges very much into the cavity of the right one. In the internal structure of both ventricles, the surface appears rugged and irregular towards the opening of the auricles, and smooth and pervious as it leads to the artery.

7. The pulmonary artery carries out the blood from the right ventricle near to the opening where the auricle receives it; and the artery assumes here a triangular, irregular shape, arising from its valve. This valve consists of three knobs, behind which, is a dilatation or little bag, termed a sinus. The structure, indeed, of all the valves in the mouths of the great arteries is similar. They are three in number, originating from the circle of the artery as it rises from the heart. In their shape they are semilunar, with their loose edge hanging into the artery; and, when they unite together, they complete a circle, and close the mouth of the artery, so that nothing can pass. By the action

of the ventricle, the blood is pushed into the artery; and, by the contractile power of the latter it is carried forward to the lungs, from which it is returned to,

8. The left auricle of the heart, which differs something from the right, in its smaller sinus and larger auricle. This sinus is formed by the pulmonary veins, which come in four great trunks from the lungs, two from the right side, and two from the left. At each side of the left auricle, two great veins then enter, which give it a square form, and the whole left sinus is turned backwards towards the spine, is more of a cubic form than the right one, but resembles it in the uniformity and smoothness of its outer and inner surfaces.

9. The valve of the left auricle, from its smaller size, and particular form, is termed the mitral valve, resembling in appearance the form of a mitre. In every other respect, the structure of the two auricles agrees. The left ventricle, again, is longer than the right one, is smaller in its cavity, and stronger in its fleshy columns.

10. The semilunar valves of the aorta resemble those of the pulmonary artery, and only exceed in superior strength; and, being furnished with small hard tubercles placed on the apex of each valve, they meet when it is closed, and give more resistance, so as to prevent the valve being forced.

11. The aorta arises by a large strong opening from its ventricle, and exceeds in size the pul-

monary artery, swelling out so as to form three divisions; the curvature at the arch of the aorta being called its great sinus, and the other three, the lesser sinuses of the aorta.

## DXCIX.

Such is the general view of the structure of that organ, so necessary to the support of life; and the next point that remains is, by what means is its own circulation supplied, so as to enable it to give circulation to the body. This takes place by means of the two first branches the aorta gives off, which possess a peculiar and beautiful structure. They arise immediately under the valves of the aorta, are termed coronary arteries, and are two in number, while their veins terminate by one trunk in the right auricle. In their progress, one of the coronary arteries runs in a groove between the right auricle and ventricle, and gives circulation to the right side of the heart. The other is distributed partly between the left auricle and ventricle, and partly in the groove between the ventricles on the forepart of the heart, supplying the left side of the heart, and forming communications with the other artery. From their peculiar origin, it has been doubted whether their supply of blood corresponded to the general laws of the circulation, and was received from the aorta, or immediately from the heart; but the former of these seems chiefly established.

The coronary veins return the blood from the corresponding arteries, and they join chiefly into a great trunk, named the great coronary vein; which, after making a turn from the left side of the heart, and running between the left auricle and ventricle, terminates in the under part of the right auricle, covered by its semilunar valve.

## DC.

To finish the description of the heart, there remains the cuspachian valve, situated at the mouth of the ascending cava, where it joins the sinus. In its form it resembles a crescent, with its convex edge fixed to the union of the sinus and cava; and the concave edge turned obliquely upwards, reaching about half way over the mouth of the cava. In its size and appearance, it varies much in different subjects. This valve is equally distinct in the adult as in the foetus; but in the former it is frequently found reticulated, an appearance seldom met with in the latter.

It is considered in the adult as preventing the blood of the auricle from passing into the inferior cava; and in the foetus, as directing the blood of the superior cava to the foramen ovale which lies behind it, and the remains of which always continue conspicuous.

## DCI.

The heart then is a hollow muscle, situated in the cavity of the thorax, of a conical figure, with

its base placed backwards next the spine, while its body and apex are turned forwards and obliquely over to the left side. In quadrupeds, it is placed in a line with the sternum, and the point only touches the diaphragm; but in man, the point is a little lower than the base, and projects between the two lobes of the left lung, a little below the left nipple, where the pulsation may be felt. Its situation, however, always varies a little from the position of the body, and the state of respiration. Nor have instances been wanting where the heart has occupied the right side of the thorax, though they are rare; and its situation has been even known to be altered by disease.

#### DCII.

The heart is covered by a particular membrane or sac, named the pericardium. It is one of the strongest in the body, adapted to the organ it contains. It consists of two layers, the external of which is a continuation of the mediastinum that passes to the lungs and lateral parts of the diaphragm. The internal is smooth, tendinous, and polished on its inner surface, and also of greater strength than the former.

#### DCIII.

This membrane adheres to the tendinous part of the diaphragm, and contains a liquor which serves to lubricate the heart and facilitate its mo-



tions, undergoing the same secretion and absorption as in other parts of the body. In its extent, this covering passes also a considerable way beyond the base of the heart, including the large blood vessels at their roots or origin; and thus it forms angles, or cornua, corresponding to their curvature.

## DCIV.

The internal membrane of the heart, which is glued to its muscular fibres, when it reaches the entrance to its cavity, is reflected, becomes thicker, and by its continuation forms the internal layer of the pericardium, already noticed. The cellular substance connected with the outside of the pericardium, is connected with the vessels, runs along them for some way, and gives to them additional strength and firmness. The uses of the external membrane and pericardium are apparent from their situation and connections. The pericardium evidently serves to sustain the heart in its place, to prevent it from shifting too much, from bearing by its weight upon the vessels that enter it, and from disturbing the functions of the lungs; and hence, both pleura and mediastinum are continued down over the pericardium, as we shall afterwards perceive.

## DCV.

When the pericardium is cut into, the inner surface of it, as well as the outer surface of

the heart, is slippery, arising from the liquor, we already observed, that the pericardium contains; and this liquor exudes from the extremities of vessels so very minute, that they escape observation. Besides this, there is constantly found collected a quantity of fat between the outer membrane of the heart and the flesh, and that in persons who are otherwise greatly emaciated; and this fat must exude to mix with the secreted liquors, just as we shall find it do from the omentum within the abdomen; so, while the connection of the heart to the neighbouring parts is prevented, it slides and plays without injury to itself, or to the neighbouring organs.

## DCVI.

On proceeding into the heart itself, and comparing its substance with the other muscles, its fibres are more closely connected than the common muscular fibres are, whereby they serve better to contain the blood; and, perhaps, farther they are endowed with greater powers of motion, and are more exquisitely sensible than those of the other muscles. The fleshy fibres in general proceed from, or terminate above, the mouths of the ventricles; and hence every part of the heart contracts towards this place. The auricles descend towards it, and the ventricles are drawn upwards towards it, while the heart is admirably adapted, straitening itself in all its dimensions. It

is an error to suppose that the heart, when in action, is only made narrower. This supposition has arisen from observing, that when the ventricle is in action, the heart strikes the side: but this depends chiefly upon the particular kind of motion of the ventricle, while, at the same time, it is brought nearer to the side by the arteries and auricles filling at once; for the blood begins to be stopped and accumulated while the ventricle is in action, in consequence of which the heart turns as it were upon its axis, which is placed about the basis of the heart.

## DCVII.

In reviewing the cavities of the heart, we are naturally led to the causes which determine the blood in a certain course through them, beginning with the *venæ cavæ*.

These we have seen meet to form the right sinus, which is evidently muscular, as is likewise the termination of the *vena cava*, which has the same structure as the sinus, contracting like it, and that in a very remarkable degree. What we call auricles, form a common cavity with the sinus; and, as a proof of this, it is only necessary to compare the two sides, for, on the right side, the auricle is larger, and the sinus less; on the left, again, these proportions are reversed. At the entrance of the inferior or ascending cava, we find a tumescence of the edge of the auricle, or valve, named

after Eustachius, to prevent the blood from falling down into the cava in our erect posture. Where the auricle is joined to the ventricle, we perceive the *valvulæ tricuspidæ*, so named from its being broader in three places, and which serves to direct the course of the blood into the ventricle. The connection of the valve to the side of the ventricle is made by fleshy pillars, the use of which is not, as some anatomists have supposed, to open the valve, but to prevent the valve, when the heart is in action, from being turned back into the auricle. We are not to suppose that these pillars are in action at one time, and all the rest of the heart at another, but rather they are in action at the same time with the sides of the ventricle. The inner side of the ventricle is every where unequal, with a number of fleshy pillars, and an attention to these might be sufficient to convince us, that every drop of the blood is not squeezed out at every contraction of the heart, but it is very nearly so, inasmuch, that in small animals it changes its colour. We can never imagine that every hollow or depression has its corresponding rising to enter it, so that some small part of the blood still remains.

## DCVIII.

From the right ventricle is the only passage left into the pulmonary artery; and at the mouth of the artery are three valves, named *sygmoidal*. They are entirely membranous, formed of the inner

membrane of the heart and arteries lengthened out. The pulmonary artery is divided into two great branches, one to each lobe of the lungs; and the blood is returned by four great veins, which terminate in the left sinus. With this sinus a small auricle is connected, the cavity of the whole being nearly equal to that of the right side, but hardly so large; then there is a similar passage into the ventricle, and a passage from thence into the aorta. The chief difference here is in the thickness and strength, for a greater force is necessary to drive the blood through the numerous branches of the aorta, than to drive it through the lungs; and, if we are to judge of the force by the thickness, it is nearly three to one. The valves, &c. are nearly the same as in the right auricle, and the valves at the beginning of the aorta are named semilunares. The blood is then carried by the aorta to all the different parts of the body, and is returned again to the heart by the vena cava, as is evident from examining the heart. A valvular structure, it may be observed, is wanting in two places where it might be expected, being at the termination of the veins into the auricle. Thus there are no valves at the termination of the cava and pulmonary veins to prevent the blood from being thrown back. The reason of this would appear, that there might be a danger from preventing a degree of regurgita-

tion in certain cases from the forcing of blood constantly forwards into the heart; but, even in the ordinary course of the blood a valve is not necessary, the current in the veins being sufficient to direct the course of the blood; and it can only appear difficult to account for the want of valves to those who look upon the heart as acting like a spring, so that as much force is used to fill the ventricle as it employs in emptying itself. But the ventricle is altogether relaxed so soon as it is emptied, so that a very gentle effort of the auricle is sufficient to fill it. Whereas, in consequence of the suddenness and violence with which the ventricle contracts, the blood would have been thrown every where, were there not a valve between the auricle and ventricle.

## DCIX.

### *Chemical Analysis of the Heart.*

The structure of the heart differs from the other soft muscular parts in its greater proportion of fibrine. The secretion of its covering, or the pericardium, consists of a gelatino albuminous water.

### *Anatomical Preparation of the Heart.*

From the importance of the heart, as the principal organ of the body, it has been commonly selected, that its structure may be well understood, as a fit subject for preparation, and the organ has been either dried, or injected, and corroded for this purpose.

### *Dry Preparation.*

1. To make a dry preparation, a heart should be

chosen free from fat, nor is it necessary to preserve any length of vessels. The cavities and internal surfaces should be well washed out, and the organ macerated in water for several days, or as long as may be without weakening the parts by putrefaction; that when finished, it may be as transparent as possible. When sufficiently macerated, the extremities of the vessels are to be tied up, but a pipe is first to be fixed in the superior cava, entering the right auricle to fill the right side of the heart, and another is to be tied to one of the pulmonary veins, entering the left auricle in order to fill the left side. The organ is then to be injected with melted tallow, and afterwards suspended in the air till perfectly dry; and this should be continued some weeks, even after the outside appears dry. When the drying is finished, the extremities of the vessels are then to be cut off, and such openings made into the auricles and ventricles as will afford the best inspection of the internal parts. It should then be placed at a proper distance from the fire, and in such positions as will be best adapted for melting and draining out the tallow from the cavities and vessels, which should be strictly done, and in doing it, avoid excess of heat. When finished, the preparation should be coated with white spirit varnish.

*Corroded Preparation.*

2. For the purposes of corrosion, a heart, whether fat or lean, may be equally chosen. When taken out of the body, it is to be washed very clean, taking care that there be no coagulum left, in which particular precaution is required. The water being thoroughly

drained, a pipe is to be fixed in the superior cava to inject the right side, and another in one of the pulmonary veins to inject the left side. The mouths of all the other vessels are then to be secured by a ligature, and the two sides of the heart injected with different coloured injections. When cold, the pipes are to be removed, and the part put into the corroding liquor, which should consist of three parts of muriatic acid to one of water, and remain there for three or four weeks, or such longer time, till the soft parts are destroyed. The preparation is then to be washed, and an exact model of the internal parts of the heart, and the large blood vessels will be thus procured. To preserve it, it should be varnished, and placed under a cover to preserve it from injury.

## DCX.

Before proceeding to any detail of the vascular system, it will be proper, after the heart, to take a general view of the principal organs concerned in the circulation. On this plan we are first led to the examination of the lungs.

## DCXI.

*Lungs.*

The lungs, we find, are two soft spongy bodies, filling the greater part of the cavity of the breast, bounded by the two bags of the pleura, and every where in contact with the adjacent parts, so as to admit no intervening air, or other fluid, between them and the thorax.



## DCXII.

In their shape they exactly correspond to the inside of the thorax or cavity they fill. Thus they are rounded towards the ribs, hollow towards the diaphragm, and irregularly flattened and depressed towards the heart.

## DCXIII.

The colour of this organ varies somewhat at different periods of life. In children, the lungs exhibit a reddish or pink colour. In adults, they possess a light blue or greyish appearance; and, in old age, they become more of a purple and livid hue, with the occasional traces of black spots in different parts of their substance.

## DCXIV.

The connections of the lungs to the adjacent parts are not numerous. Above, they are joined to the neck by the trachea (CCXCIX); by the two layers of the mediastinum to the spine, and to the heart by the pulmonary vessels. In other parts they are entirely free, and become only connected in consequence of disease.

## DXCV.

From their situation and division, the lungs are separated into two parts; and this separation is made between them by the heart, and the farther intervention of the mediastinum. They are distinguished therefore into their right and left portions.

## DCXVI.

Each of these portions is farther subdivided into what are termed lobes; and by this division their motions are facilitated, and the dilatations of the different parts rendered more simple and easy; (three of which belong to the right portion of the lungs, and only two to the left). For these two last purposes, also, we find a still farther subdivision prevail; for the lobes consist of smaller parts of different sizes, and of an irregular angular shape; and these smaller parts receive again the appellation of lobules.

## DCXVII.

The lobules, as they diminish in size, degenerate at last into small vesicles, or cells; and these vesicles constitute a large part of the substance of the lungs, and on which their peculiar function depends.

## DCXVIII.

The structure of the cells is membranous. In their figure they are irregular. They are compressed and closely connected; and they possess a free communication and intercourse with each other.

## DCXIX.

The whole of these parts described are connected by cellular membrane, which is interposed between them, unites and strengthens them, and

is the medium through which their circulation is distributed. It possesses, however, no immediate communication with the cells, which are only affected through the trachea, and in no other way; and it is also totally destitute of fat in this situation.

The coverings of the lungs consist of two coats, the external and internal; the first is a continuation of the pleura, or general covering of the thorax, which is merely extended over their outer surface. The latter, though adhering to the former, both covers their surface, and also insinuates itself into every part of their substance.

#### DCXX.

From this view, then, the lungs are contiguous to the pleura, every part of the thorax pressing against another; and those who have entertained a contrary opinion, have been misled, by drawing too close an analogy between animals of very different kinds, as from birds, where the trachea arteria perforates the lungs, and communicates with cavities beyond them. But the lungs are adapted to follow the motions of the thorax, and every circumstance shews the continuity of parts; even when the lungs are in a collapsed state, they exactly represent the containing parts, and we then find a partial, and sometimes a total adhesion of the lungs to the pleura. Upon opening the thorax, we see no passages by which air can

get into it; we find the lungs touching the pleura; and, if we open the pleura under water, no bubbles of air rise through the water. So that the lungs fill the chest, and we can very well understand the reason of this. We need only attend to the effect of the air on a weather-glass, where the weight of it is sufficient to sustain the weight of about 30 perpendicular inches of quicksilver, and it is able to keep up water to the height of 30 feet and more; it is surely sufficient therefore to expand the lungs, and keep them contiguous to the pleura. If this then is understood, it only remains, in order to explain respiration, that we understand the structure of the thorax, and the manner in which its parts may be enlarged and contracted, and we may view the lungs merely as bladders, and consider them as passive, as they certainly are with respect to their dilatation; and it is ridiculous for surgeons to talk of the lungs expanding themselves so as to throw out matter that is collected within them. With regard to their contraction, they have a certain degree of elasticity, as some of the muscular fibres of the trachea extend to their remotest cells; but the effect of these must be inconsiderable; so that, while the dilatation depends upon the containing parts, the contraction depends almost upon the very same thing.

## DCXXI.

In explaining then respiration, we observe that any solid body may be enlarged in three ways, in length, breadth, and depth, so we dilate the thorax in all these ways. The diaphragm is excellently fitted for lengthening out the cavities of the thorax, for we have seen it pressed up into the thorax like the crown of one's hat; and, when in action, its fibres become straight, and the cavities of the thorax are elongated, and the abdominal muscles are put upon the stretch, or are pushed outwards. Next, we may observe that our ribs are fitted for making the thorax broader, for increasing the distance between the two sides, and, at the same time, for rendering it deeper, or for increasing its distance between the sternum and spine. Thus, if you bring the ribs to be more perpendicular, the sternum is pushed away from the spine, for the upper ribs being more fixed, whilst the under ones are moved upwards towards them, they are turned outwards; and, as the ends of the ribs have thrown in betwixt them a cartilage, which is crooked, this is thrust out, so that the distance between the sides is increased. The power by which this motion is performed, is beyond all doubt, the contraction of both the rows of the intercostal muscles; at the same instant, when these contract, the most moveable part moves towards the one that is the

more fixed. The only difficulty here, and which has puzzled many anatomists, is to account for the obliquity of the intercostal muscles.

## DCXXII.

This has been already explained, and from this obliquity we have proved that great powers of action are acquired by them, and these powers are also increased by their being wanting near to the sternum and spine. (CCCCLXVIII, &c.)

## DCXXIII.

Supposing, then, we have made a full inspiration, and after a little we feel an uneasiness, and mean to expire, the parts are replaced in this manner. The diaphragm is replaced by its elasticity in some measure, because in its action it pulls down the elastic membranes within the thorax, stretching the mediastinum to a certain degree. The elastic air contained within the stomach and intestines, and which does not readily escape, will also have some effect; but the diaphragm is chiefly replaced by the contraction of the abdominal muscles. For, as soon as we cease from acting with it, the abdominal muscles are solicited to act, to press the bowels of the abdomen upwards against the diaphragm, so as to bring it to its natural place, which is more especially necessary in the erect posture; when we are laid horizontally, the elasticity of the parts and weight of the bowels in a manner do the

business. For replacing the ribs, the cartilages are sufficient for the purpose even in the dead body, inasmuch, that we always find the body in the state of expiration. But farther as the abdominal muscles in expiration are brought into action in order to replace the diaphragm, the external oblique being fixed to the ribs, must also have the effect of drawing them downwards. When the muscles of the abdomen push the bowels of the abdomen inwards and upwards, they must also have the effect of drawing the ribs directly downwards; and, when we want to perform the expiration with greater force, we exert these muscles in a still greater degree. But, if we want to perform it with violence, every muscle, though destined principally for the motion of the trunk or extremities, may be brought to influence the ribs.

## DCXXIV.

Now, after we understand the manner of respiration in life, we readily know the use of the division of the thorax by a partition, the mediastinum; for we perceive that a wound made in the thorax through the pleura must be attended with a great degree of danger, as in consequence of the admission of the air, a collapse of the lungs from the natural elasticity must take place, and we could not have it in our power to dilate and contract them alternately. Whereas, in conse-

quence of this division, we can make a shift to live, though perhaps a very considerable opening be made in one side, for the lungs will not collapse when one side is wounded, as they do in a dead body upon the opening of the thorax, for then the other side is at rest, and their natural tone bring them to a small compass, but the oppression from the wound occasions a great exertion with the other side in order to dilate the thorax; and whilst a great deal of air enters through the wound, some likewise goes by the trachea arteria to the wounded side, so that there is a very small dilatation in that side. In this case too, the expiration is performed with the like violence, and the glottis is in a great measure contracted. Hence the air is thrown from the sound side into the wounded, so that there is an inspiration of the wounded side, while there is an expiration of the other, and in that way life may be continued. Besides, this partition serves for conducting the vessels for supporting the parts, &c.

#### DCXXV.

##### *Chemical Analysis of the Function of the Lungs.*

The function of respiration is one of the most important of the animal body, and it is only from the discoveries of chemistry that its uses have been fully understood. It consists of two actions; inspiration, by which we draw air into the lungs, and expiration, by



which we expel it from them. The air drawn into the lungs is clearly atmospheric air. In an adult, each inspiration carries in about 30 cubic inches of it, and as in the space of a minute we inspire 15 times, hence there is required every minute 450 inches of this fluid, every hour there is required 27,000 ditto, and in 24 hours 648,000 ditto.

2. This atmospheric air acts in two ways; 1<sup>st</sup>, by its weight and elasticity in dilating the pulmonary vesicles, and thus allowing the regular progress of the circulation of the lungs; and 2<sup>dly</sup>, the purpose for which it is principally required, by communicating to the blood of the pulmonary veins vital air, on which the continuance of life depends.

The uses of vital air mixed with the blood are:

a. To give the proper irritation to the heart exciting it to act.

b. To produce the arterious blood, or communicate to it its florid red colour.

c. To produce animal heat, in consequence of the vital air being decomposed by the animal gas or carbonated hydrogen.

d. To disengage the carbon from the animal gas, and allow it to pass into the venal blood.

3. Correspondent to these principles, the air expired from the lungs is a different composition from that received, and consists of

a. Water, for polished glass, we find moistened by it.

b. Carbonic acid gas, or fixed air, as proved by the precipitation of lime if breathed through lime water.

c. Azotic gas, for it suffocates animals, and extinguishes the flame of a candle.

4. Thus, by respiration, important changes are produced. The venous blood absorbs oxygen, and acquires in consequence a florid red colour; and the same must happen also to the chyle, as none of this fluid can be discovered when it passes the lungs, and the whole is uniformly red. From the chyle, also, it would appear farther that hydrogen and carbon are abstracted in consequence of this absorption, in order to allow it to be converted into fibrine, or that matter which is necessary to the formation and repair of the solid parts.

Nor does the use of oxygen terminate here, on it is dependent the temperature of the body; and the quantity of air breathed by the different classes of animals, determines the actual height of their temperature. Thus the temperature of man is only 96, while that of birds, who breathe more, is equal to 103 or 104.

*Anatomical Preparation of the Lungs.*

The ramifications of the air vessels may be exhibited in a preparation made by maceration. For this purpose, the lungs of a dead born child should be procured, and they should be first macerated in water till they become sufficiently putrid to break down the texture of the blood vessels, cellular membrane, &c. and which should be washed away with the finger and thumb, while the preparation is held under water, changing the water frequently as it becomes thick and turbid with the pulpy matter that washes off, and that it may be seen when the ramifications of the bronchiæ are sufficiently freed from all extraneous substance. The preparation is then to be put into spirit of wine, diluted with an equal quantity of water.

## DCXXVI.

To finish the demonstration of the thorax, it only remains to examine its investing membranes, the pleura and mediastinum.

## \* DCXXVII.

*Pleura.*

The pleura is that membrane which lines the inner side of the thorax, and covers most of its contents. It is a part of considerable strength. Externally, its surface is cellular, and adheres strongly to the surrounding parts. Internally, it is smooth, and moistened by a lymphatic secretion from its vessels.

## DCXXVIII.

It is divided into two sacs or bags, corresponding to the shape of the surrounding cavity of the thorax, and its various connections are to the periosteum of the ribs, to the intercostal and sterno-costal muscles, and to the sternum and dorsal vertebræ, while it is expanded also, as we have seen, over the pericardium, the lungs, and the lateral or fleshy parts of the diaphragm.

## DCXXIX.

Behind the sternum, the two bags of the pleura unite to form a partition, termed the mediastinum, which extends between the sternum and vertebræ, but is intercepted by the heart and root of the lungs, and divides the thorax into two distinct

## AND DISSECTION. cccclxxxviii

cavities, which have no communication with each other.

### DCXXX.

The office of the pleura is to smooth the internal surface of the thorax, and render the motions of the contiguous parts easy upon each other, to form divisions of the thorax for the proper lodging of its organs, and to strengthen its general fabric.

### DCXXXI.

#### *Mediastinum.*

The mediastinum, or reflexion of the pleura, is a double membrane, passing directly across the the breast, and containing between its layers a quantity of cellular substance, forming the bond of their union.

### DCXXXII.

It is divided into two parts, the anterior and posterior mediastinum; the former of which is situated at the fore, and the latter at the back part of the thorax; the one being joined to the sternum, and the other to the pericardium and vessels of the heart.

### DCXXXIII.

At its forepart, the layers of the mediastinum are closely applied to each other, except where they are separated at the upper part of the chest by the remains of the foetal peculiarity in the structure of the heart, the thymus gland.

DCXXXIV.

To mark the situation of the mediastinum with precision, we observe that its upper part lies exactly behind the middle of the sternum; and that, as it descends, it inclines gradually towards the left edge of the bone. From this obliquity, it is found that a pointed instrument pushed through the sternum, is generally found to enter into the right side of the thorax. But this descent of the mediastinum is by no means regular, as it is at times entirely perpendicular, and at other times its obliquity is to the right, instead of the left side.

DCXXXV.

On its back part, the mediastinum extends from the base of the lungs and back of the heart to the vertebræ of the back; and, between the layers of this division of the mediastinum, is situated the under end of the trachea, the œsophagus, the descending aorta, and several other parts.

DCXXXVI.

The general uses of the mediastinum are to form a division of the chest, to support its general contents, to hinder the two lobes of the lungs from pressing on each other when in a recumbent posture, and to prevent the passage of fluids where they may chance to be collected from dis-  
ease, from communicating to every part.

## DCXXXVII.

Having thus examined the contents of the thorax, we are now prepared for tracing the circulation of its organs; and, in order to do this, we shall begin with examining the action of the heart.

## DCXXXVIII.

*Action of the Heart.*

In its muscular structure, all the fibres of the heart observe an oblique direction; and, in its most interior parts, they mix and cross each other, so as to form a sort of net-work, rendering it in texture the strongest muscle of the body. From this form of its structure, which gives it the greatest strength, so the same arrangement gives it also the greatest irritability. It is the part first conspicuous in life, and it is the part which retains longest the living state, and this life is even greater on its internal than external surface.

## DCXXXIX.

The power by which the heart is moved, is the stimulus and quantity of the blood, and this quantity must be in such proportion as to give a due fullness or distension to its several parts.

## DCXL.

In its action, the heart moves upon its basis as upon a centre. Its point rises and curves so

as to strike against the ribs; and the dilatation of the heart is such, that during it, it turns upon its axis one way, and by its contraction, this is reversed the other way.

## DCXLI.

The situation of the heart, in all animals, we find determined by that of the lungs, and this situation is occasionally altered in a slight degree by disease, or is liable to be somewhat displaced. In its situation it is suspended by the mediastinum and its great vessels, in its motions it is confined, sustained, and regulated by the pericardium, and for its exertions it depends on its own irritability, and the impulse of its distending fluid, the blood.

## DCXLII.

*Blood.*

The blood is a fluid of a rich colour, varying somewhat in its shade of red in different vessels, being florid or vermilion coloured in the arteries, purple or dark red in the veins, and almost black at the right side of the heart. In its consistence, this fluid is thick and unctuous to the feel, and to the taste it is slightly saline and ferruginous. It varies, however, in different parts of the body, and is also somewhat different in different animals.

## DCXLIII.

This fluid is resolved, as we formerly noticed, into three parts, the red globules, gluten, and serosity.

## DCXLIV.

*Red Globules.*

The first is a part which has much exercised the attention of anatomists. The red appearance is not general in every animal; but formal particles, corresponding to its structure, though not to its colour, are met with in all animals, and these of very different sizes in different animals. The form of the globules is much undetermined. These globules, when the blood stands, fall to the bottom, and they preserve their form only when in the blood, and are as it were supported by the serum. In water they are totally dissolved, and the fluid acquires from this a red tinge. Their proportion to the other parts of the blood is uncertain, and liable to variety, according to the state of the body. They are increased by health, vigour, and exercise, and they are lessened by weakness and disease. They are always most apparent in the centre of the system, and in some animals they are only seen in the great vessels round the heart. Though iron is supposed the cause of this colour of the red particles, the point is by no means completely established, when such a very small portion only is detected, as 1 grain to 400 grains of the fluid.

## DCXLV.

*Gluten.*

The next part of the blood, its gluten, or



coagulable lymph, is more important than the former, and is the part of the fluid most generally dispersed through the system. It is from this part all the solids of the body are formed, and its relation to the body is extensive and surprising. It is the basis of every part that possesses life. It is secreted by the vessels to repair all the waste and accidents of the body, and it is, on the whole, that particular form of matter designed by Nature for our chief nourishment and support.

## DCXLVI.

*Serosity.*

The last part of the blood, or serum, is properly its water, blending with it whatever is extraneous, and proper to be discharged. It is of a yellowish or greenish colour, of an unctuous slippery feel, slightly saline and alkaline to the taste, holding in solution a proportion of gluten, and preserving the red globules in their proper form.

## DCXLVII.

From this view, then, the uses of the three distinct parts of the blood are plain. By its serosity is the mass distributed, all extraneous matters removed from it, and the several secretions kept up and regularly carried on; for it possesses sufficient dilution to pervade every part, consistence enough to prevent exudation, and saline impregnation sufficient for preserving the form of the

globules. By the red globules is the action of the heart, round which they are accumulated, and the circulation of the large vessels properly promoted; and, by the gluten, is an ample supply furnished for repairing the waste and decay of every part of the system. Thus the blood is properly the analysis of all the fluids. On its gluten depend all the internal secretions, and on its serum all the external excretions or discharges.

## DCXLVIII.

With this constitution of the blood in view, we are next to examine the extent of the changes induced on it by its oxydation in the lungs.

## DCXLIX.

The oxydation of the blood, already noticed, is a process of the first importance to animal life. For the perfection of this process alone is the lungs formed, and in order that a constant and regular change for the necessities of the system may proceed. The connection, therefore, of respiration with the great principle of life is apparent, and still more so, when its effect on the blood is separately examined.

## DCL.

The first effect of atmospheric air, is its brightening the colour of the blood, which none but it and vital air accomplishes, and in a quantity of blood

this only takes place on those parts of its surface which are exposed to the air.

#### DCLI.

The second effect, along with this increase of colour, is giving to the fluid an increased stimulus, or what we may term the energy of life. This stimulus it gradually loses as it proceeds in its course through the system, and it requires to be renewed by its transition again for this purpose to the heart, and from the latter to the lungs. By means of vital air alone, this stimulus can be carried to an excessive degree, and the animal even destroyed by excess of excitement.

#### DCLII.

The third effect of this process is the generation of heat, in consequence of the increased action which the vessels receive from the new stimulus communicated to the blood by respiration. This generation of heat, therefore, depends on the distribution of oxygen through the body; which, as it enters into combination, gives out the matter of heat; and the same thing is also assisted by the various processes of the body which convert the gaseous parts into fluids, and the fluids into solids; for by all those different changes heat cannot be given out.

## DCLIII.

These effects, then, are accomplished by the perpetual and rapid motion of the blood through the lungs; and, in this motion it draws from the atmospheric air, to which it is exposed, that portion of vital air sufficient for the purpose. The proportion of vital air contained in atmospheric, is only 27 parts out of the 100; and, of this vital air absorbed, only one half is deposited in the circulation. The other, as formerly observed, goes to extricate the excess of carbon and hydrogen in the system, and to discharge it by the lungs.

## DCLIV.

From this view, the proportion of vital air we employ is but small, as it constitutes but  $\frac{1}{4}$  part of what we actually breathe; and of that, even one half is immediately discharged again from the system in combination with the carbon and hydrogen present in the lungs. A greater supply of it would produce an incitement incompatible with the continuance of life; and, like the rapid movements of a flame, exhaust the matter to which it is applied.

## DCLV.

The movements in respiration are strongly influenced by the action of the diaphragm. By this muscle the belly is protruded, and an enlargement of the thorax takes place, which enlargement

occasions the lungs to descend, and gives free access to the air through the trachea to enter their vesicles and distend them. By this protrusion of the belly, the abdominal muscles are next excited to re-act. By their action or pressure, the form of the diaphragm is restored or urged to its natural situation, and rises into the thorax. Thus the cavity of the latter is straitened, the lungs are compressed, and the air is again expelled from their cavity. In producing these effects, the diaphragm however does not act alone, but is assisted by the thorax, whose intercostal muscles are subservient to this purpose.

## DCLVI.

The animals that do not breathe, it was formerly stated, possess only a single heart, and not any provision for the circulation of the lungs; we are naturally led to enquire, after our examination of this organ in man, by what means the circulation of the lungs is dispensed with in the child before birth.

## DCLVII.

*Fœtal Circulation.*

In the child, we find the heart perform but a single office; and, in order to do this, both its auricles communicate by an opening passing between them, so that no quantity of blood passes through the lungs more than any other part of

common structure, and the system of the child is therefore entirely oxydated through that of the mother.

## DCLVIII.

The structure for this purpose is curious and important. From the placenta of the mother, the maternal blood is transmitted by the umbilical vein to the foetus; and this blood, from the system of the mother, must possess a degree of oxydation suited to the state of constitution of the foetus. In entering the latter, therefore, that no part of this oxydation may be lost till it reach the heart, it passes in two directions, one part going through the liver of the foetus, and the other part through the ductus venosus under the liver, directly to the heart.

## DCLIX.

The heart, then, is stimulated by this fluid; and, that the lungs may not be called into action, the communication between the two auricles allows it to pass directly to both sides of the heart, termed the foramen ovale. The circulation of the foetus, it is next to be observed, is more extensive than that of the adult, as besides its own body, the temporary circulation of the placenta must also be carried on by it. To accomplish this, and give additional force to its circulation, an appendage is formed to the aorta below its curve by its inosculation with a branch of the pulmonary

## **cccxcviii ' DEMONSTRATION**

artery, named the *ductus arteriosus*. The aorta, thus increased in size by this junction, acquires additional force and action, corresponding to what is required for the more extended circulation of the *foetus*; receiving the impulse of the left ventricle through the aorta, and of the right one through the *ductus arteriosus*.

### **DCLX.**

Thus the blood, after pervading the system of the *foetus*, is returned in its effete state through the two iliac arteries, reflected along the side of the bladder into the placenta to pass to the system of the mother. During pregnancy, therefore, her lungs are required to oxydate her own system as well as that of the *foetus*, and her circulation is loaded with its own impurities as well as those which the system of the *foetus* creates.

### **DCLXI.**

From this view, the maternal blood passes along the umbilical vein, which adhering to the internal surface of the abdomen, enters the liver at the upper part of the cleft which divides this organ into two lobes; and, after entering the liver, it distributes branches to the right and left. Next, the *ductus venosus* comes off from the umbilical vein, and proceeds in a short curved course, joining the largest of the hepatic veins, and going directly into the right auricle of the heart.

## DCLXII.

Then appears the foramen ovale, the uses of which are clearly demonstrated from its structure, for its valve is placed on the side of the left auricle, which marks the course of its blood. It is of a somewhat rounded shape, and in its situation it lies at the very backmost point of the partition between the two auricles. It is placed high up, with a circular ring round its borders, thick and muscular at its edge, and on the left side entirely is placed the valve, perfectly transparent and delicate, but strong. This transparency remains when it is closed after birth; so that by this structure, the blood of the foetus in the heart passes immediately from right to left, and into both ventricles; from the left ventricle it is discharged into the aorta, and from the right one into the ductus venosus. This duct is a middle branch between the two great pulmonary arteries, assuming their place, receiving the blood, passing on also in a straight line towards the aorta, and joining immediately below its arch, so as to produce a foetal aorta of double strength and size.

## DCLXIII.

Such is the course of the foetal circulation. In its office, one heart only belongs properly to the foetus, and when birth takes place, and respiration begins, the double office of the heart then



commences. The flow of the blood into the lungs immediately stops the circulation of the ductus arteriosus, and the blood entering the left auricle of the heart from the lungs, presses down as it fills the valve of the foramen ovale, and completes the partition between the auricles for ever after.

# DCLXIV.

## *Chemical Analysis of the Blood.*

After this view of the circulation, and an account of the blood, it is proper we should next enter into the chemical analysis of this fluid more particularly.

1. The quantity of this fluid in the body of an adult, is generally rated at 28 lbs. ; of this quantity, the proportion in the veins is four parts, and in the arteries only one fifth.

2. The colour of the blood has been already remarked to be florid red in the arteries, and dark in the veins, except in the pulmonary ones. The general colour is supposed to depend on the presence of iron oxydated by the lungs. The floridness of the arterial blood on the presence of oxygen, and the darkness of the venal blood on the accumulation of carbon,

3. The heat of the blood is about 96 degrees of F. and the arterial blood is warmer than the venal.

4. In taste, the blood is saltish, with a somewhat urinous smell when fresh drawn. In gravity it exceeds water, and in consistence it is glutinous and adhesive.

5. The parts of the blood were already considered. When submitted to the action of fire it gives out,

1. Water, soon turning putrid.

2. Empyreumatic oil.
3. Ammoniacal spirit ; and
4. Carbone.
5. The principles of the blood then are ;
  1. Animal gas or carbonated hydrogen.
  2. Cruor ; and
  3. Albuminous serum.

Another principle has been also noticed, termed the bilefcent, refembling in its appearance the cystic bile.

6. With these remarks on the general constitution of the blood, we examine more particularly its separate parts, as divided into cruor and serum.

7. The cruor consists of the red mass concentered into a cake. It forms more than one half the quantity of the blood. It is thick, elastic, and glutinous like jelly ; and its specific gravity is ten times to that of water. In the temperature of the air it putrifies, and is insoluble in water. Its surface, exposed to the air, acquires a florid red, which is soon lost by being excluded from it. This depends on its absorption of oxygen, which has the same effect when the blood is contained in a bladder. On being fully saturated with oxygen, it blackens by degrees, and its floridness can never again be restored.

8 The constituent parts of the cruor are ;

1. The red globules, which consist of fibrous gluten and oxydated iron ; the latter in such small proportion, that from 25 lbs. of blood, only two drachms of oxyd of iron were obtained.

2. Fibrous gluten, resolvable into carbon and azote. This is proved by washing the cruor when the red parts

separate in the water, and a white fibrous tenacious mass is only left.

9. The serum of the blood is the lymphatic fluid that swims upon the cruor. It possesses something of a saline taste. It is of a yellowish green colour, and forms nearly one half of the blood. With cold water it unites, but with boiling water it coagulates, and a part becomes white. By continuing the boiling it again separates.

10. The principles of the serum are;

1. Water; for, from 47 oz. of serum, 43 of water are obtained by distillation, which shows a strong disposition to putrescency.

2. Albuminous gluten; for, stirred with a stick, it separates a large quantity of gluten, and the same is done by converting it into ice, and by other methods.

3. Jelly; for, when coagulated by heat, the part of the serum that does not coagulate, assumes in cooling the appearance of a tremulous jelly.

4. Aerated soda; as appears by adding to recent diluted serum mineral acids, a neutral salt being obtained.

5. Culinary salt and phosphorated calx.

11. The albuminous principle, or coagulable lymph, is analagous to the white of an egg. It possesses neither taste nor smell; is of a white opaque colour; is firm in consistence, and by heat it is converted into a horny substance.

12. Its elementary principles appear to be carbone, azote, and hydrogen.

13. Along with the principles described, there is also

separated from the blood an acriform elastic fluid or animal gas. It ascends from the blood when warm, and received on a glass, collects on its sides like dew. It possesses a peculiar smell, which is strong in carnivorous animals; and, when an animal is newly killed in cold weather, it is emitted in the form of vapour.

14. The constituent principles of this gas are carbonated hydrogen, as demonstrated by shutting up recent drawn blood in vital air, the vital air being thus converted into carbonic or fixed air, and the hydrogen of the animal gas being converted into water; and, to do this, as we formerly noticed, is one of the chief objects of respiration, thus extricating the excess of these principles from the body.

#### DCLXV.

We are now led to consider the circulation from the heart, as it is expanded through the thorax. The aorta, or great artery, from its arch bends downwards and backwards, and touches the left side of the spine. The two membranes of the pleura we have seen meet in the middle to form the mediastinum, leaving a triangular space, the basis of which is the spine. The sides of this space, or membranes of the pleura, incline to each other, and between their interstice the aorta is lodged, and along with it lies the œsophagus, which runs down, as formerly pointed out, towards the stomach, and there also lie some other parts. The aorta, thus descending near the spine, gives out the following arterial branches: 1. It

gives off small arteries, which nourish the proper substance of the lungs, or the bronchial ones. Next, as it lies by the side of the œsophagus, it supplies it with small twigs, the œsophageal arteries. Lastly, in its descent, it gives off a small twig to the interstice of each rib; and these are named the intercostal arteries.

## DCLXVI.

Of these arteries, the bronchial first claim attention, which are the proper nourishing arteries of the lungs, and form a set of vessels distinct from the pulmonic ones, which are exclusively appropriated to their oxydation. The bronchial arteries are therefore immediately attached to the trachea, and follow its course, or continuation, through all the ramifications of the substance of the lungs.

## DCLXVII.

*Arteria Bronchialis Communis.*

The first branch of them is the common bronchial artery, so named from being distributed to both sides of the lungs. It arises from the fore part of the aorta, and gives a branch to each side of the lungs; besides which, the right branch gives a vessel to the œsophagus, and sometimes it passes itself entirely to this part.

## DCLXVIII.

*Arteria Bronchialis Dextra.*

Like the former, this sometimes originates from

the aorta, but oftener from the upper intercostal artery. It proceeds round the right branch of the trachea; and it is confined alone to that side of the lungs. Several branches are also sent off by it to different parts, as to the œsophagus, back of the pericardium, and the same part of the mediastinum.

## DCLXIX.

*Arteria Bronchialis Sinistra.*

The origin of this vessel is the fore part of the aorta, whence it descends with the bronchialis communis. It proceeds to the left side of the lungs, and gives off some branches to the neighbouring parts.

## DCLXX.

*Arteria Bronchialis Inferior.*

This artery is not always met with; but when it occurs, it arises from about the place of the fifth rib. It proceeds to the back part of the heart, above the left pulmonic vein, is extended into the auricle, and along with it passes into the substance of the lungs.

## DCLXXI.

Such are the bronchial arteries. In their origin, as we have described, they are irregular, proceeding in different cases from the aorta, mammary artery, or upper intercostal one, and not unfrequently from the intercostals of the aorta.

Their number of branches, however, is generally four, and their office is clear and established.

## DCLXXII.

*Arteriæ Œsophageæ.*

These arteries arise from the aorta, below the former. They encircle the œsophagus in the form of small twigs, five or six in number; and they anatomise in their course with each other. From the œsophagus they proceed to the back of the mediastinum, and being joined by some small branches from the aorta, they form what have been named the posterior mediastinal arteries.

## DCLXXIII.

*Intercoſtales Inferiores.*

The number of the lower intercostal branches varies with the number of ribs they supply. This depends upon the extent of the upper intercostal artery, which generally supplies two, and sometimes three upper ribs. The lower intercostal arteries, therefore, are generally nine or ten in number; they are given out from the aorta in its descent along the spine, and it apportions one as it passes each vertebra for each rib. Hence they are properly termed intercostals in the thorax and lumbar arteries in the loins. On the right side they are longer than on the left, from the situation of the aorta with respect to the spine; and, besides supplying the ribs, these arteries give off

small branches to the œsophagus and mediastinum.

## DCLXXIV.

. The distribution of each intercostal artery in its course is extensive.

From the head of each rib it gives off three small branches to the spine. One for the substance of each vertebra; one for the sheath of the spinal marrow; and one for the substance of the spinal marrow itself. Near the head of each rib a large branch is next sent off, perforating to the back, and giving circulation to the large muscles there, which it solely supplies.

In the extent of the rib, the intercostal artery gives off numerous small branches to the intercostal muscles; and it also, in its course, divides into two branches, one of which is large, and attached to the lower edge of the rib above it, and circulating in a groove for that purpose. The other, smaller, adheres to the upper edge of the lower rib. In their progress, both advance to the fore part of the thorax, and anastomose with the mammary and epigastric arteries.

## DCLXXV.

In this way is the circulation of the thorax conducted. The pulmonary vessels divide into two branches, which, like the bronchial, pass to right and left, and are distributed on the lungs.  
--The minute branches running in the common



cellular substance, form at last a plexus upon the proper cells, from which the halitus is derived, expelled by the lungs in expiration. The pulmonary veins, which return the blood from the lungs to the left auricle of the heart, are smaller in proportion to their corresponding arteries, than the veins are to the arteries in other parts of the body, which has been ascribed to the large quantity of fluids expired; and perhaps, also, that the blood may be longer detained in its passage from the lungs, and, of course, longer exposed to the action of the atmosphere. These veins, however, join into four principal trunks, terminating all in the left auricle.

## DCLXXVI.

Such is the arterial circulation of the thorax. These arteries described, possess all their corresponding veins. Thus the bronchial arteries return their blood by these veins to the azygos, and left superior intercostal vein. In the thorax, no very great arterial branches arise from the aorta, or are given off for its circulation. It is, when\* it passes through the thorax above and below, that its largest branches are distributed, and the circulation of the thorax is confined chiefly to the four we have described. The coronary arteries for the heart itself; the bronchial and pulmonary vessels for the lungs; the œsopha-

gial arteries for that part; and the inferior intercostals for the ribs and spine.

## DCLXXVII.

Having thus examined the organs of the thorax, proceeding downwards, we are led next to those that fill the abdomen, beginning with their general investing membrane, the peritonæum.

## DCLXXVIII.

*Peritonæum.*

The peritonæum is the investing membrane of the abdominal cavity, which appears on removing the muscles, and is spread round the bowels, and partly supports them. It is a firm simple membrane, highly elastic, and admits of great extension, as is proved both in pregnancy and disease. When the cause, also, of extension is removed, it regains its former dimensions.

## DCLXXIX.

Like that of the other membranes already examined, its two surfaces differ. The external one is rough and cellular, so as to connect itself closely with the parts to which it is in contact. The internal one is smooth, slippery, and lubricated by an exhalation from its own vessels.

## / DCLXXX.

5      'ent of this membrane is very confi-  
      't forms the lining of the diaphragm,  
      down, covering the abdominal muscles.

It next lines the pelvis and its contained parts. It is then reflected back, and covers the muscles; and last, by its reduplications, it is expanded over the bowels and great blood vessels of the whole cavity. In its passage to different bowels, doublings are formed by it, which serve as ligaments to attach them to each other, and likewise to suspend them to the body.

## DCLXXI.

Thus the peritonæum allows to most of the bowels a general covering, and only where they are very deep seated, does it appear to be partial. By its expansion, a large sac is formed; which, on the back part, is bounded by its adhesion to the different viscera; and before, is confined by the abdominal muscles. Being loose, however, upon the contents of the cavity, it allows them some freedom of motion.

## DCLXXII.

The external surface of this membrane is covered with cellular substance, which varies in its thickness and manner of attachment in different parts. On the bowels it is extremely thin. In other places, as the kidneys, it is filled with a considerable quantity of fat; and, in particular situations, as on the spermatic cords, it sends off various processes without any interference with the internal membrane, being unaccompanied by it.

## DCLXXXIII.

Thus the uses of the peritonæum are extensive and important; and, besides those which have been observed of inclosing, supporting, and connecting the different parts, it prevents any injurious effects from friction by the smoothness and lubricity of its surface.

## DCLXXXIV.

With this demonstration of their covering, we proceed to the examination of the bowels within the peritonæum, which we find serving three different purposes : viz.

Those that serve for the reception or preparation of the aliment, so called the chylopoetic viscera, or the stomach and alimentary canal; as also other viscera that are assisting to this, and which pour in liquors, as the liver and pancreas, and we shall perhaps find it probable that the spleen is subservient to the liver in preparing the bile. When the chylopoetic viscera are removed, we find the urinary organs, and at the undermost part of the general cavity we find the organs of generation; and, to allow an easy motion, we shall find a quantity of fat, and an organ named omentum. We commence our detail with the stomach, leaving the examination of this part, till afterwards.

## DCLXXXV.

*Stomach.*

The stomach is a large membranous bag, placed under the diaphragm. In its figure it is somewhat oblong and round, and has been compared in shape to the appearance of a bag-pipe. It is turned downwards and forwards, so as to form an angle with the œsophagus, and this angle is increased by the distension of the organ.

## DCLXXXVI.

The size of this organ is various, and much proportioned to the quantity of aliment the individual is accustomed to receive. Hence it is larger in men than in women, and in the former is frequently increased by mode of life to an enormous size.

## DCLXXXVII.

This organ has been divided by anatomists into a variety of parts, and the first that claims attention are its two orifices. The former, the left, or upper orifice, constitutes the termination of the œsophagus, and it is named the cardia. It is opposed to the spine, at a little distance from it. It allows a free passage for the blood into the organ, the return of which is prevented by the angle of the stomach at this part, and by the fleshy structure of the cardia and the diaphragm, in which it is situated. The latter, the right, or

inferior orifice, is turned from its office to discharge the contents, pylorus, and forms the commencement of the duodenum or intestines. Its situation is a little to the right side of the spine, under the small lobe of the liver, and it is turned more forwards than the upper orifice, though its situation is altered somewhat by the particular state of the organ.

## DCLXXXVIII.

The second part of the stomach that claims attention, are its surfaces, the upper one turned towards the diaphragm, the under one towards the intestines; but, when the abdomen is opened, the superior surface appears anterior, and the inferior surface posterior, so that they only deserve the former appellations when the stomach is considerably distended.

## DCLXXXIX.

The curvatures of the stomach form its next division, being divided into two, the large and small one. The large curvature extends from the one orifice to the other, is placed towards the abdominal muscles, and is turned obliquely forwards and downwards. The small curvature is opposite to this, extends also between the orifices, is placed towards the spine, and in a direction backwards and upwards.

## DCXC.

After tracing these different divisions of the organ, its general structure falls to be considered. From its connection above, it must be regarded simply as an expansion of the œsophagus; but, from its peculiar office, it appears possessed of certain additional powers for the alteration of its contents. Holding this in view, we find it, when subjected to examination, divisible into four distinct layers or coats.

## DCXCI.

The first, or external coat, is evidently derived from the peritonæum, being a reflection of it from its expansion on the liver. By this coat, the strength of the organ is increased. The effects of friction are diminished, and the sensibility of the other parts which expose it to pain, or inflammation, are greatly lessened. Between this coat and the next, there is interposed also a quantity of cellular substance, which assists in the same general effect of increasing its strength and diminishing its sensibility, and forms the medium of connection with its internal layers. This part has ever been described as a separate covering.

## DCXCII.

The second, or muscular coat, is a **more** important one, and it consists of fibres **variously** disposed, but chiefly longitudinal and transverse.

The longitudinal fibres are evidently continued from those of the œsophagus, which extending to the stomach, are disseminated in various directions, but they chiefly follow the general course of the organ from the upper to the under extremity. Upon each side of the small curvature, in particular, they form a thick, strong, muscular band.

The transverse fibres are those peculiar to the organ. They are considerably thicker and stronger than the former, and they are also placed more internal. By this muscular coat, the organ is endowed with much power of action, and in proof of it, we find from continued causes of irritation, that the cavity of the organ comes to be much contracted in consequence. It is by means of this coat, that what is termed the vermicular motion of the stomach takes place; for, at the left orifice it begins to contract, and proceeds with a regular and circular motion, each part contracting in order, and last of all the pylorus; and, in this motion, the one set of fibres shorten the organ, while the other renders it narrower; and this second set is even intersected by many small tendinous divisions, which, limiting their extent, increase their power.

## DCXCIII.

The third coat, is what is termed the nervous coat, which is formed by a modified expansion of cellular texture, and composes as it were a



bed for the connection and circulation of the inner coat or proper one of the organ, on which its peculiar function, or epigastric secretion, more immediately depends. It is therefore intimately connected with the inner coat, possessing many small aponeuretic filaments which cross each other obliquely, and intermix to support the connection.

## DCXCIV.

The fourth, or villous coat of the stomach, is of a complex texture. It possesses a structure similar to that of the internal surface of the œsophagus, for the separation of mucus, to sheath the organ from irritation, or the too powerful action of its contents, and it possesses besides a peculiar set of vessels both for secretion and absorption. It is formed of fine short, prominent villi, highly vascular, and largely rugated or divided into folds. The extent, therefore, of the inner coats, is much greater than the outer, and the peculiar structure of the rugæ is their leading distinction.

## DCXCV.

These rugæ run for the most part in a waving transverse direction, and these divide into a sort of net-work, or reticulated structure. They yield to distension; and are most distinct when the stomach is in an empty state; and, by this distension, it is probable the stimulus of action is

given to their vessels. By this folded structure, therefore, their vessels are fitted to expand without injury, and the aliment is detained longer upon their surface in its progress through the organ.

## DCXCVI.

From the inner surface of the stomach proceeds a peculiar fluid, approaching in its nature to the saliva, termed the gastric juice. The origin of this fluid is evidently from the internal coat, and on the presence of this fluid the peculiar function of the stomach depends.

## DCXCVII.

*Chemical Analysis of the Gastric Fluid.*

That process, termed *Digestion*, by which the contents of the stomach are converted into chyme, or the foundation of nourishment, is chiefly effected by this fluid.

1. When examined, it is limpid like water, or occasionally tinged with the yellow colour of the bile. It has no smell, and possesses something of a saltish taste.

In its gravity it is lighter than the blood, and is somewhat viscid from its mixture with mucus, being seldom procured in a pure state.

In its nature it varies in different animals, and shews also different powers.

In the graminivorous animals, it turns the syrup of violets green, and does not act on animal food with activity.

In the carnivorous tribe, it turns the syrup of violets red, and shews little action on vegetable food.

In man, the colour of the syrup is not altered by it, and it acts equally on food of both kinds.

2. This fluid readily unites with water, is only precipitated by alcohol, and resists putrefaction in an eminent degree. The peculiar quality it possesses is the coagulation of milk, and so strongly does it retain this property, that the stomach dried and washed, possesses still the same quality.

3. The constituent principles of this fluid, as far as yet detected, we find to be ;

*a.* Water, which constitutes its greatest portion.

*b.* Albumen, as precipitated by alcohol.

*c.* Culinary salt, detected by chemical analysis.

*d.* Uncombined phosphoric acid, which is never wanting.

4. An artificial gastric juice, it is said, has been formed by macerating fresh flesh in a solution of culinary salt.

5. The gastric fluid acts independent of the stomach and food, in metal tubes is digested by it. In a proper temperature, chyme is also formed by it out of the body. It also acts on the stomach itself, so soon as the extinction of the vital principle takes place.

7. The process of digestion, therefore, may be termed an animalizing solution, assisted by heat, and hardly by triture.

## DCXCVIII.

### INTESTINES.

The termination of the stomach takes place in a long cylindrical canal, which winds in various directions. The commencement of this canal is at the pylorus, or under orifice of the stomach,

and this orifice is formed by the reflected doubling of the two inner coats which project into the passage between the stomach and intestines, and form a ring of muscular fibres that compose a sphincter, termed the sphincter of the pylorus. The intestinal canal then descending from this sphincter, occupies a large part of the abdomen, and contains in its various convolutions a length, supposed equal to six times the length of the body in its ordinary size. This proportion, therefore, is greater in those of a diminished stature, than in others. To the body the intestines are connected, or held in their place by their peritoneal covering; and, in their progress from their different dimensions or capacity, at different places, they have been arranged into two general divisions, the small and large intestines.

## DCXCIX.

*Small Intestines.*

The small intestines display externally a smoothness of surface, and taper somewhat in their form, or gradually lessen in their diameter from their upper to their under extremity. They admit a division into three parts, of the duodenum, jejunum, and ilium.

## DCC.

*Duodenum.*

The duodenum, so termed from its length, supposed equal to 12 fingers' breadth, possesses the same

structure as the œsophagus and stomach, from which it begins. In its course, it passes first on in a transverse direction to the right side, and goes somewhat backwards, as far as the neck of the gall bladder, having the anterior layer of the omentum fixed to its inferior part, and the lesser omentum to its opposite side. It then proceeds obliquely downwards to the right side, before the great vessels that go into the liver, and before the venal artery and vein, included in the cellular part of the mesocolon. Opposite to the under part of the kidney, it turns to the left side to be lodged in the common root of the mesocolon and mesentery, and receives into its back part the extremities of the biliary and pancreatic ducts, going over the aorta and vena cava opposite to the last vertebra of the back. From these vessels it makes another curve towards the right, being involved in the root of the mesentery, and getting afterwards to the left side of the spine, it perforates the mesentery and mesocolon, and makes a turn forwards, when it receives the appellation of jejunum.

## DCCI.

*Jejunum.*

The jejunum, beginning at this part, derives its name from being generally the emptiest of the intestines, in consequence of the thinner part of its contents being sooner absorbed. It begins at

the last turn of the duodenum, is redder than the other parts, and its numerous convolutions, which run in all directions, are confined to the upper part of the umbilical region.

## DCCII.

*Ilium.*

The ilium, the next division, is distinguished externally from the former by its smaller size, and the greater thinness and paleness of its coats, and in its extent it forms about  $\frac{3}{5}$  of the length of the two intestines. Its name is derived from its numerous convolutions, which extend from the under part of the umbilical over the hypogastric and iliac regions, not unfrequently into the pelvis. In this extent it surrounds the lateral parts of the former division, and is supported by the ossa ilia. In its last turn, passing across the upper edge of the iliac bone, it terminates in a valve at the beginning of the colon.

## DCCIII.

Such is the general course of the smaller intestines, and it is not very necessary to distinguish that part of them named jejunum, from its being supposed to be empty of chyle, from that part named ilium, and physicians seldom make the distinction, comprehending both parts under the name of ilium, so they call it an iliac passion, whatever part of the gut may be affected.

The intestines are nearly, but not altogether, of a cylindrical shape when distended, their coats are thin, and as we go down they gradually become more pellucid.

## DCCIV.

Thus the division between the small and great intestines is made by the ilium passing into a great sack, which makes the beginning of an intestine, named very universally the colon; this enters the caput coli nearly at right angles, when the colon is lengthened out some way, and is lodged in the hollow of the os ilium, and this we would name the caput cæcum coli; and from that part goes off the appendix vermiformis.

## DCCV.

*Great Intestines.*

In their form, the great intestines resemble the small ones. They compose one continued canal, which gradually lessens in dimensions from its upper to near its under extremity, but in their size they greatly exceed them, and in their course they are also short and straight, compared with the small intestines. Their external surface displays an irregular appearance; they are locked up into cells, and a number of processes arise from them. They admit, however, a similar division to the smaller intestines, and are composed of three parts, the cæcum, colon, and rectum.

## DCCVI.

*Cæcum.*

Under the insertion of the ilium lies the cæcum, or blind gut, consisting of a short bag, three fingers' breadth long, and of the same diameter, extending to the dilated beginning of the colon. Its situation is the right iliac region, under the iliac convolutions, and resting on the cavity of the iliac bone, at the under extremity of the right kidney. It is placed so that its bottom descends, forming a shut sac, with its mouth turned towards the colon, termed the caput cæcum coli. On the posterior part of the cæcum, there is also a small process, in its diameter about the size of a goose quill, and hardly more than two or three inches long, named the appendix vermiformis. It displays a convoluted structure, fixed by its sides to the cæcum, with two extremities, one impervious, and the other with an oblique opening into the back part of the gut.

## DCCVII.

*Colon.*

The colon, the next division, exceeds in length all the other intestines. It is a production of the cæcum, beginning at the termination of the ilium, it encircles the small intestines, and is in contact with most of the abdominal viscera. Hence its course is complex, and variously convoluted. It rises in the right iliac region over the kidney, to



which it is connected, and reaches the height of the angle of the right hypochondrium. It then runs transversely under the liver and stomach, especially to the spleen, in doing which, this part of it receives the name of the great arch of the colon. In the left hypochondrium, it turns backwards under the spleen, and descends on the fore part of the kidney, to which it is connected. In this situation it forms two convolutions, compared in shape to the Greek sigma, and thence named its sigmoid flexure. The length of this flexure varies in different cases, extending at times as far as the cæcum. Through its whole extent, this intestine is fixed to its situation by the mesocolon.

## DCCVIII.

*Rectum.*

From its straight situation when viewed anteriorly, the name of the last division of the intestines, or the rectum, is derived. Its situation is the lowest of the lumbar vertebræ, and it descends in its progress upon the fore side of the os sacrum and coccyx, terminating in the anus, a little beyond the extremity of the last bone. Its course is regulated by the direction of the bones, over which it passes. Thus it is inclined somewhat downwards at its rise, then a little backwards, and afterwards turns forwards. It differs from the other intestines in becoming wider in its progress downwards, and forming below a refer-

voir for the fœces. Its termination is named the anus, where it contracts into a narrow orifice, the sides of which are disposed in close longitudinal folds. The rectum is fixed to its situation by means of the meso-rectus.

## DCCIX.

In this account of the intestines, some small parts remain to be detailed. The first are the *apendiculæ pinguedinosæ*, situated on the outer surface of the great intestines, particularly the colon, at different distances from each other, and projecting from the intestines like so many pendulous papillæ, the use of which is evidently to lubricate these parts. Of the same nature, also, are the adipose strata in the sides of the adhesions of the mesocolon. The surface of the colon is also intersected longitudinally through its whole course, by certain ligaments like bands, which appear to divide it into three parts. One of them extends along each side of it, and the third is concealed by the attachment of the mesocolon.

## DCCX.

After the stomach and intestines, what we may term their appendages, or the mesentery and omentum, fall to be examined, the former serving to connect the intestines to their situation, the latter to lubricate the cavity over which they are spread.

## DCCXI.

*Mesentery.*

The mesentery is a reflected production of the peritonæum, which detached, includes the intestines as in a sling; and, from its situation with respect to them, is it named. It consists of three parts; one uniting the small intestines, which receives the proper name of mesentery; another connecting the great intestines, termed mesocolon, and a third attached to the rectum, named mesorectum.

## DCCXII.

*Proper Mesentery.*

The first part begins at the last turn of the duodenum, running obliquely downwards to the right side, and along the vertebræ of the loins, to the three first of which it is connected. Between its layers are inclosed cellular substance and much fat, and the vessels and nerves of the jejunum and ilium take the same direction. From the convolutions of the intestines, with which it corresponds, the extent of its anterior edge is much greater than its posterior one, being formed into plaits or folds.

## DCCXIII.

*Mesocolon.*

At the lower extremity of the ilium, the mesocolon, the second division of the mesentery, and its continuation, begins. It is here contracted in

size, and following the course of the great stines, they are fixed by it in their place. Under the right kidney it forms the right ligament of the colon, becoming for this purpose narrow and firm. Next, by the immediate adhesion of the colon to the kidney and duodenum, there is an apparent want of meso-colon opposite to this place. From this turning across, in order to inclose the arch of the colon at its anterior edge, it forms a broad expansion, and behind it is fixed to the spine, first separating and inclosing the anterior part of the duodenum. On the left side, the first connection of the meso-colon is to the under part of the left extremity of the stomach, and descending over the left kidney, it forms at its under end the left ligament of the colon. It then forms an adhesion to the large psoas muscle, expanding for this purpose, and the sigmoid flexure of the colon is retained in a loose fold of it.

## DCCXIV.

*Mesorectum.*

The mesorectum, or last division of the mesentery, begins with the lowest vertebra of the loins. Then it contracts by degrees, becomes narrow, and disappears at the under part of the pelvis, at which part the rectum forms an immediate attachment to the os sacrum.

## DCCXV.

Thus the office of the mesentery serves to suspend, to connect, and retain the several intestines in their proper situation, to afford them an external coat, and to allow a proper distribution of their circulation.

## DCCXVI.

*Omentum.*

The omentum is a fatty membrane expanded over a large portion of the abdominal viscera; and, in consequence of this expansion, it admits of three divisions into the omentum of the stomach, liver, and colon.

In youth, in its form, it composes a distinct bag, but becomes connected and reticulated by age. It is divisible in its structure into layers, the outer of which is a peritoneal covering reflected from the stomach.

## DCCXVII.

The anterior layer of the first omental division, is a continuation of the peritoneal coat which externally covers the stomach, and is extended here from its upper and under surfaces. From its origin it is spread over the bowels, reaching as far as the spleen, and descending a little below the umbilicus, especially in fat people. It possesses, however, no adhesion to the abdominal muscles immediately behind which it is placed. At the

under edge it is reflected, and ascends, forming the posterior layer. In this ascent it forms no adhesion till it reaches the arch of the colon, to which, and to the vessels of the spleen, it is connected.

## DCCXVIII.

The second division of the omentum arises from the arch of the colon, in the same manner as the former part does from the stomach, and is connected to the cæcum by a particular cuneiform process.

## DCCXIX.

The third division, or hepatic omentum, receives various appellations, and is rather a membrane from its possessing little fat in its composition. It is connected to the small curvature of the stomach at its edge, and to the beginning of the duodenum; and, for this purpose, it passes to the under and back part of the liver, from the fore part of the sinus of the aorta. In its structure, like the other parts, this division of the omentum consists of two layers, but has no reflexion upwards. On reaching the stomach, a division of its layers takes place; and, by this division, they take a direction so as to inclose the organ, and form its external coat. On gaining its great curvature, however, their reunion takes place; and, by this reunion, they pass on to form the anterior and reflected portion of the first

division, while this reflected part separating again, closes over the colon to form its external covering, and then uniting at its opposite surface, is continued under the name of the mesocolon.

## DCCXX.

By this distribution, the third division appears the original and most expanded part, and by it an irregular bag or cavity is formed, containing the hepatic omentum, stomach, and first division of the omentum in its anterior part; and the reflected portion of the first division, the colon, and mesocolon in its posterior part.

## DCCXXI.

At the upper and right side of this sac, or behind the cord which leads to the hepatic vessels, is situated the semicircular passage, formed of two ligaments from the peritonæum, termed Winslow's foramen, equal to a finger in size, and maintaining a communication between the large sac of the omentum, and the common cavity of the abdomen, so as to allow fluids to pass readily from the one to the other.

## DCCXXII.

The evident use of the omentum, from its fatty nature, is to lubricate the bowels, and prevent injury from friction.

## DCCXXIII.

Having thus examined, in a general way, the appearance and situation of the chylopoetic viscera, we shall now consider, first, their general circulation; and then review the leading circumstances of their structure.

## DCCXXIV.

From the thorax, the aorta descends under the arch formed by the legs of the diaphragm into the abdomen. When it has passed, it directs its course pretty near the middle of the vertebræ, embraced by the tendinous arch of the diaphragm. In this course it wants the cava, which, on leaving the pelvis, inclines to the right side, and passes under the liver in order to reach the right auricle of the heart.

## DCCXXV.

In its progress the aorta forms numerous connections. Its first branch attaches it to the mesentery, and in the same way to the thoracic duct. Its other branch attaches it to a number of large nerves descending to be distributed on these parts. On proceeding into the abdomen, it first dispenses a small arterial twig to the diaphragm; it then gives off the celiac artery which supplies the liver, stomach, and spleen. Its next branch is sent off for the circulation of the intestines, named the great mesenteric artery; and



its last distribution is made to the lower intestines by the lower mesenteric artery. The particulars of this distribution it is next proper to trace.

## DCCXXVI.

*Arteriæ Phrenicæ.*

The circulation of the diaphragm, we find, depends on two arteries named phrenicæ, which pass one to each side of it. In the situation, however, and number of these arteries, there is considerable variety, as at one time they take their origin from the aorta at different places of it, at another time they arise partly from the aorta, and partly from the celiac artery. They are generally two, but sometimes they are found to be increased to three or four. In their most common number and progress, one goes round each side of the diaphragm, and each crossing the fleshy part of the crus of its own side, bends along to the ala or wing, from which it gives in all directions a greater number of branches to the fleshy sides of the diaphragm. From the wing, it then turns round and encircles the great central tendon; and, before this, each artery gives off one large branch to the fleshy sides of the diaphragm arising from the ribs. All their remaining branches are then spread on the central tendon and sternal part of the muscle, inosculating largely together in these situations. One branch from these arteries is also sent often to the peri-

cardium, when it is connected with the diaphragm.

## DCCXXVII.

Before passing into the diaphragm, the phrenicæ give small branches to other parts, particularly to the renal capsules and œsophagus. Besides the phrenic arteries, the diaphragm is also supplied by branches from the intercostal, lumbar, and capsular arteries, as well as from the thorax.

## DCCXXVIII.

*Arteria Cœliaca.*

The next, and a very important artery, is the cœliac. Its origin is from the fore part of the aorta, under the 11th vertebra of the back, and where the course of the diaphragm embraces it in the form of a thick short tube, encircled by the lesser arch of the stomach. It then immediately divides into three branches, the middle one of which goes to the stomach, the left to the spleen, and the right to the liver. Of these, the smallest is the middle one, the largest in the adult the left one, but in the fœtus the right one.

## DCCXXIX.

*Arteria Coronaria Ventriculi.*

This central cœliac branch is about the size of a crow quill. It rises upwards, and turns a little towards the left side from the situation of the pylorus; but, before reaching this orifice, it is divided into two great branches, one encircling

the cardia, the other distributed along the lesser arch.

DCCXXX.

*Arteria Coronaria Superior.*

At its rise from the diaphragm, the œsophagus receives this cardiac branch, which turns round it, and, after various convolutions, appears on the left side of the stomach, over which it is spread. In the middle of this course it gives off a branch, which pursuing the base of the posterior surface of the œsophagus, passes into the thorax, and unites with the upper œsophagean arteries.

The second is a continuation of the same cardiac branch, sending its ramifications down over the large part of the stomach, somewhat in the shape of a crown, and ending in its inosculation with the vasa brevia from the spleen.

The second branch distributed along the lesser arch of the stomach, as formerly noticed, may be said properly to be the right division of the former. It turns from the root of the œsophagus round the lesser arch, bending according to its curvature, and distributing branches down, both forwards and backwards, over each side of the stomach. By these branches on the stomach it runs to be spent, and arrives with a very small trunk at the pylorus. From the stomach, it turns upon the small gut, or continues its connection to both, and is named *arteria pylorica superior*.

Several other arteries are distributed on the stomach from the other organs, which fall to be afterwards noticed, when treating of these organs.

## DCCXXXI.

*Arteria Mesenterica.*

The next arteries are the mesenteric, or those that supply the intestines, and they are so named from lying within the two layers of the mesentery. The first, or superior, gives its branches to the colon and the small intestines. The second, or inferior, attaches itself to the left side, and supplies the lower part of the colon and rectum.

## DCCXXXII.

*Superior.*

The former is the largest of the abdominal arteries. Its origin is not more than half an inch below the celiac artery, from that part of the aorta betwixt the legs of the diaphragm. It then passes under the pancreas, and through the mesocolon or the proper mesentery of the small intestines. The first turn is to the left, and then to the right side of the abdomen, and on getting low into the abdomen, it gives off several branches. To the right it gives three principal branches, but to the left they are so innumerable, as not to admit any particular detail; and their anastomoses are so great, as to form a plexus carrying the artery down to the left ilium, where the con-

junction of the ilium with the colon lies. The principal branches it gives to the right side, viz. the colico-media, dextra, and ilio-colica.

### DCCXXXIII.

#### *Colica Media.*

The first passes between the two lamellæ of the mesocolon, and divides into two great branches before reaching the intestines, one turning back along the right side of the colon, and inosculating with the colic arteries; the other turning upwards, and bending according to the curvature of the arch of the colon, till after rounding it to the left side, it inosculates with the left colic artery, or branch of the inferior mesenteric.

### DCCXXXIV.

#### *Colica Dextra.*

This branch is sometimes separate, but more commonly its origin is from the middle colic artery. It is a large branch set off at a crooked angle. Its course is along the right side of the colon, dividing as it approaches the intestine into two branches, one turning upwards to join the middle colic artery, the other passing downwards to attach itself to the ilio-colic artery.

### DCCXXXV.

#### *Arteria Ilio-Colica*

Is a long small artery, arising about an inch below the last, and passing to that part where the

small intestines terminate, and the large ones begin or run along the mesentery towards the joining of the ilium with the colon. It terminates in three regular branches, one passing straight on to the junction of the ilium and colon, divides there into two lesser branches; one of which traverses the fore, the other the back part of the caput cecum, being connected with the valve within:—another branch runs backwards along the colon, and inosculates with the right colic artery; and a third runs down along the ilium to join the branches of the mesenteric artery. It is from these diverging branches this artery is so named. The appendix vermiformis has also a mesentery tying it down, and from the caput coli an artery runs down to supply this mesentery, pervading the whole length of the process.

## DCCXXXVI.

These, then, are the branches of the mesenteric artery to the right; to the left, they are so numerous as to form a great net-work of small arteries for the supply of the small intestines. The first, or radical branches, are from 12 to 20 in number, thick, short, and large. From these, secondary ramifications arise equally numerous; and from the last, farther ones take their origin. Each of these sets inosculate with each other, mouth to mouth, in the form of arches, and, in the end, from the last of these inosculating plexus,

## ccccxxviii DEMONSTRATION

the arteries go out straight upon the intestines, and are there expanded. By this distribution, the mesentery acquires an irregular matted appearance, and as its arteries redouble and increase in numbers, the last of them makes a curvature, to serve the ilium, and inosculates with the ilio-colic artery.

### DCCXXXVII.

#### *Inferior.*

The lower mesenteric arises very obliquely from the left side of the aorta, to which it keeps close for a great way, and at the bifurcation of the aorta, it sends off its great branch to the left side of the colon, viz. the left colic artery. It then descends to the pelvis, turning down over the iliac artery of the left side, and ends with the rectum.

The left colic artery, its principal branch, divides into three others, which go off from the trunk at short broken-like angles. The first ascends into the angle of the colon, and divides into two; the one follows the course of the intestine, and nourishes it; the other, running in the middle of the mesocolon, meets the upper mesenteric branch, and forms with it the mesenteric arch. The second passes directly to the right side of the colon, and on approaching the intestines, divides into two parts, one turning up, and the other going down.

## AND DISSECTION. cccxxxix

The third runs obliquely down to the part of the gut lying on the haunch bone, or the sigmoid flexure of the colon, and from the membrane of the colon, being here connected closely with the loins, it gives off small branches to this part, which anastomose with the lumbar arteries.

### DCCXXXVIII.

#### *Arterix Hemorrhoidales.*

This artery, the internal hemorrhoidal, is the trunk of the lower mesenteric within the pelvis. It is often equal in size to a writing quill, and is closely applied to the back part of the rectum, its whole length turning in over the pelvis obliquely for this purpose. Its large branches completely encircle the rectum, and meet on its fore part, while its lower branches anastomose with the middle hemorrhoidal artery, and occasionally with those of the bladder and womb.

### DCCXXXIX.

Such is the arterial system of the chylopoetic viscera, and the arteries possess corresponding veins; distinguished chiefly by the same names. All these veins terminate in the vena porta.

### DCCXL.

Having given a description of the chylo-poetic viscera, we shall now take a review of the leading particulars of their structure. The alimentary canal, is in general composed of three, or, as



anatomists for the most part reckon, of four different parts. The external coat is the continuation of the peritonæum; the second is the fleshy or muscular one, consisting of two rows of muscular fibres, one row being disposed longitudinally, the fibres of which are exceedingly minute; but the inner layer of the fibres, the threads of which are disposed circularly, is very evident. The third coat, the innermost one, is generally named the villous, and this is connected to the muscular one, by what has been described universally as the fourth coat, under the name of the nervous; but it is rather to be considered as the medium serving to join these, resembling the subcutaneous cellular substance, or which serves the same office to the intestines, that the subcutaneous cellular membrane does to the skin. In several respects, however, it seems different; it wants the fatty bags connected to the cellular substance, and the threads are shorter.

## DCCXLI.

On inverting the small intestines, there are a number of rugæ or doublings, on the villous and nervous coats, which make a resistance to the contents, the valvulæ conniventes; by stretching them, we can make the gut smooth: but it requires some force to do this, and it is likely that they retain pretty constantly their place. Probably the villi are again lesser valves, similar to

the larger; at least the surface by means of the villi, is very greatly increased. The number of the rugæ, or valves, in the small intestines, is continually diminishing as you descend, and the appearance of the villi is always in proportion to the appearance of the larger valves; and in the larger intestines, there is not much room for speaking of either.

## DCCXLII.

Where the small intestines are joined to the larger, we find a strait place, or valve, which is of a very curious texture. It might be imagined the end of the ilium with all its coats; but the external coat enters between the transverse or circular fibres of the colon, which gives an oblong shape to the valve, and the more you distend the colon, the more you straiten that valve, the circular fibres trying the more to bring themselves to a strait line. But besides this, the membranes at the sides, or ends of that valve, are put upon the stretch, which brings the two lips to apply to each other. So forces lodged in the caput cœcum coli will not readily return through this valve.

## DCCXLIII.

The appendix vermiformis may be considered as the beginning of the colon, as in the fœtus it lies in the same direction; but the weight of the fœces gradually pushes it down, so that the

appendix in the adult comes to make the side of the colon. In the whole tract of the intestines, from the mouth perhaps downwards, we find a vast quantity of slime, or mucus; and for the separation of this, there are a vast number of exceedingly minute glands, most of which, and much more readily the ducts from them, from their smallness, escape our observation; but in many places we can see the bags containing the slime, as in the mouth of the stomach, in the duodenum, jejunum, caput coli, and in the appendix vermiformis. In some subjects they are greatly more distinct than in others.

## DCCXLIV.

In demonstrating the intestines, the situation of the peritonæum and its extensions, claim particular regard. The peritonæum is a single membrane, so far as it is to be considered as a membrane, and owes its double appearance to the condensation of its cellular substance; in some cases it has a morbid appearance, and we find a similar appearance in other parts of the body. The cellular substance every where ties it to the other parts; and it not only lines the muscles, but covers almost all the different viscera, so as to give them an external coat; and if we suppose a very accurate dissection made, and this coat separated, we leave the peritonæum entire, and the bowels upon the outer side of it between the

peritonæum and spine. The various substances, therefore, called ligaments, or supporting membranes, are merely the continuation of the peritonæum; the mesentery and mesocolon are doublings of it; but the omentum has the peritonæum quadruple. It has been described as a double membrane; and if you suppose the colon drawn away from the stomach, and the omentum put upon the stretch, it is only double; but take it as it lies over the intestines, or if you open the abdomen, and cut through the omentum, you cut the peritonæum four times, one doubling of it being produced from the stomach, and the other from the mesocolon. The small omentum, however, is but double, because it is formed entirely from the membranes from the liver which cover the stomach only.

## DCCXLV.

Thus we may observe, that the small omentum, with both parts of the large omentum, with the covering of the stomach, colon, and pancreas, form one great sac, which has no communication with the rest of the abdomen, but by the foramen of Winslow.

## DCCXLVI.

The bowels also have a different situation after we open the body from what they have in life; so that, though we speak of the cavity of the abdomen, there-

is no such cavity in it as appears in a dead body; it is quite full, and does not contain above a tea-spoonful of liquor, so that it is a difficult matter to open the abdomen without wounding the bowels; therefore the thrusting in a trocar is a very dangerous operation in a sound animal, and it only becomes safe as in ascites, by a collection of water, which goes between the bowels and abdomen, the mesentery and mesocolon keeping the bowels connected to the backbone, while the fore parts yield to the distension; wherever water is collected in the abdomen, it is in the cavity of the peritonæum; and, as that can be traced the whole extent of the abdomen, the water varies its situation according to the situation of the body, from this circumstance a collection in the open cavity is distinguished from one formed in particular viscera.

## DCCXLVII.

The structure of the intestines or alimentary canal, is considered as composed of four different coats. The first coat, which it has from the peritonæum, by its smoothness allows one part to slide readily upon another; it does this the better, that every where from its surface a secretion is made by pores which are invisible. For, in a sound body, glands have never been seen in the peritonæum; but from every part of it we can squeeze out a liquor; and there is a farther

addition made to this from the fat of the omentum. Next, this covering gives all the hollow bowels a very considerable additional strength, so that they do not so readily give way to air distending them. Besides, there are fewer vessels in this membrane, whereby it is less favourable to concretions forming in the abdomen. We find the outer coat joined to the muscular one by cellular substance.

## DCCXLVIII.

The muscular coat is composed of two layers of fibres. The external ones run along the canal, and the circular ones run transversely. The effect of these fibres is very considerable, for no general pressure of the abdomen could possibly push on the contents, and the food does not descend to the end of the rectum by the pressure of the diaphragm, or abdominal muscles; for the turns of the intestines evidently run almost as often upwards as downwards: and in diseases, where a paralysis is brought upon these parts, although the patient continues to breathe and exercise the abdominal muscles, yet the alimentary canal is gorged with feculent matter. With regard to the manner of action, it is extremely curious: but by looking into the accounts that are commonly given of this matter, one would almost conceive that a contraction begins at our throat, and never ceases till

the substance is pushed down most regularly from top to bottom. Now, instead of this, the motions are going on at different places, and in different ways at the same time, according to the quantity and nature of the food. The general motion, from its twisting and compressing the gut, is called peristaltic; and it is understood that that motion is continued from the stomach down to the rectum: but there naturally takes place an antiperistaltic motion in animals; so that the motion of our food very much resembles the water in the ocean, by looking at which, you can scarcely determine at first whether it is coming in or going out, only there is, upon the whole, a greater motion the one way than the other. Thus, in the alimentary canal, the food is pushed on a certain way, then it is turned back a little, then it goes on again, and the two layers or fibres are both employed, but they act differently; the longitudinal fibres shortening the canal, and the circular fibres straitening it. Thus, when a morsel of food is taken down, the first thing is the shortening of the tube by the contraction of the longitudinal fibres; then the circular fibres contract chiefly from above downwards, and the food is pushed on a considerable way. The longitudinal muscles acting first, draw the gut upon the food, when the other fibres act with more advantage; and the longitudinal have the advan-

age of being fixed at the upper end by the contraction of the circular fibres.

## DCCXLIX.

The use of the antiperistaltic motion is evident, that nature means not only to prepare, but to turn the food over and over, so as to expose every part of it to the mouths of the vessels which are to receive it; and this is done in a much more accurate manner, and there is a much closer exertion of every fibre than many are aware of. We are by no means to apply the rules here that have been laid down with regard to muscles, that they are so many bladders, and only contract to a certain degree; for here they contract in such a manner as to shut the passage altogether. Thus, if a person swallows a small quantity of quicksilver, in a short time it goes through the whole canal, which it cannot possibly do by means of its weight, on account of the several turns it makes, and it must be pushed down by the ducts contracting so closely as to bring the opposite sides together. In consequence of the agitation our food suffers here, it is probably farther dissolved, and perhaps the general tendency to putrefaction is in some measure prevented; also, a new combination takes place, the great pressure occasioning the pouring out of liquors to animalize the food, and perhaps to dissolve it, like menstrua. The feculent matter is pushed downwards to be discharged from the



body, while the useful parts are received into the lacteal vessels, they are sucked in in the manner to be afterwards explained: but once these vessels are filled, the muscular coat comes to be contracted, and being crowded with valves, the food is pushed onwards towards the heart, and this is done with considerable force; for, after tying the lacteal duct, there is observed an effusion of the chyle about the mesentery, by a rupture of the larger vessels.

#### DCCL.

Within the muscular coat we find the nervous and villous coats, the nature of which has been very generally misunderstood. Authors have compared the villous coat to the cuticle upon the surface of the body: but this is altogether improper, and it leads to another mistake; for, in consequence of this, the nervous coat is supposed to represent the skin, but it is with the utmost difficulty that we can shew very minute nerves reaching any part of the nervous coat. Now, instead of this, the villous part represents not only the cuticle, but the cutis vera; the insensible skin on the inside is much thinner than the cuticle, and is shewn with difficulty. The villous coat is beyond all doubt sensible, having both nerves and blood vessels.

## DCCLI.

The nervous coat may be compared to the subcutaneous cellular membrane; only it does not contain, or suspend fat: hence it is a pure cellular substance. It is much more dense too, having much smaller cells; these, however, communicate, and, upon the whole, it serves the same purpose, allowing the villous one to play easily, and also conducting its coats and nerves. •

## DCCLII.

These two inner coats form what is called valves, the *valvulæ conniventes*; and, again, each of the valves is subdivided into villi, which may be considered as serving nearly the same purpose, viz. adding to the surface. They are not to be considered as the mouths of one, or two vessels, but as a fold of the inner coat. Upon the whole, we see nature endeavours to lengthen out the inner coat much more than the outer, and the rugæ make a greater difficulty to the passage of the food, so that it is retarded till it is fully prepared, and applied sufficiently to the surface of the intestines.

## DCCLIII.

To defend the alimentary canal from the acrimony of the substances we take in, there is a vast quantity of mucus secreted, we can in some places observe the small bags or follicles in which it is contained; and what we see in some few places, we presume to take place in all.

## DCCLIV.

After this general structure, we consider more particularly the different parts of the canal, beginning with the œsophagus. The œsophagus perforates the fleshy part of the diaphragm. One use of which is very evident, and material. Had it passed through the tendinous part, the contents of the stomach would have been easily thrown back into the mouth; whereas, by going through the fleshy part, and that swelling when the diaphragm ascends, the regurgitation is prevented, not that it is entirely shut. A liquor can be swallowed when an expiration is made; but it is made with difficulty.

## DCCLV.

From the situation of the stomach with respect to the other viscera, can be understood what is very often observed to happen in practice, that communications are made by erosions from one bowel to another. Such communications may have different effects, according to its direction. Thus, they may be slanting, so as to allow liquors to go only one way, as in the case of the gall-bladder, where there is such a slanting direction, for we can blow in air into the duodenum without distending it.

## DCCLVI.

Some circumstances with regard to the emptying of the stomach, and the filling of it, deserve

attention. There are very evident longitudinal fibres, and within these circular fibres; there is particularly a band of longitudinal fibres running along the small curvature. Instead of the stomach lying in a line with the œsophagus, when it is distended, it comes forwards, so as to make an angle with it, which serves too, to prevent our food, by a moderate pressure, from being thrown upwards into the mouth, and the pylorus is turned up or raised higher, and these membranes have the effect of straitening both orifices considerably, especially the cardia. So in vomiting, the pouring in a very great quantity of liquor, by distending the stomach to a great degree, may shut these orifices, and so endanger a rupture of the stomach; and that this does not frequently happen, is owing to this, that every one bowel supports another. All here are supported by the containing parts. The pylorus is raised upwards when the stomach is distended, for a very evident purpose; for if it had hung down, the more it was distended, the indigested aliment would have got out, whereas it is only the lighter parts that ascend and get out, and that ring at the pylorus is not merely composed of coats, but is really a circular muscle, or sphincter, which acts so vigilantly, that you will scarce find indigested food in the intestines. We know that ponderous bodies will pass down from the stomach, and that gall

stones will be thrown up by vomiting. Then the situation of the pylorus does not rise so high as the other orifice, but it is situated obliquely, and turned backwards. As we have found that the alimentary canal in general enjoys an antiperistaltic motion; so in the stomach, there is a working from the right towards the left, as well as the other way, but very gently for ordinary. If, however, a very irritating substance be introduced by an instinct of nature, the antiperistaltic motion comes to be superior to the peristaltic, and by this means the contents of the alimentary canal may be brought from the lowermost part of it upwards. Vomiting, therefore, may be explained in this manner: A nausea is produced, and the motion of the stomach is inverted, we act with the diaphragm in a slow manner, so as to push down the stomach, whereby we put the abdominal muscles upon the stretch; these are thrown into a convulsive motion, and the diaphragm yielding gently, while the matter is thrown up, the air is thrown out at the same time, so that the water, when thrown up, is generally mixed with air.

## DCCLVII.

The intestinal canal we formerly considered as divided by anatomists into the small and great intestines, and these are again farther divided. The intestine connected with the stomach, is from its length named duodenum. It is tied down very

closely to the posterior part of the diaphragm, by a cellular membrane wanting a mesentery, and of course wanting that very close covering which the continuation of the mesentery gives; while this is supplied, in some measure, by the course it takes. From the greater size of that intestine than of these that immediately follow, it has been termed the *ventriculus succenturiatus*, and perhaps the more this idea is considered, the more just it will appear; for, besides the close adhesion for supporting the stomach in its place, we observe that liquors of great importance, the bile and pancreatic juice are poured in here; and, in order to retain these longer, that they may be better incorporated with the food, that intestine, without necessity, makes several short turns, so that the food must undergo very considerable alterations here. As soon as the duodenum has got to the left side, it turns almost quite downwards; and now the mesentery begins to be added, and it gets the name of jejunum, and from this the ilium is continued, and the upper end of the jejunum is considerably wider than the lower end of the ilium; or, the tract of our small intestines is somewhat of the conical shape, with the larger end of the cone upwards.

## DCCLVIII.

A difference of colour is also observed here. The jejunum is always a great deal redder coloured, for the coats are, in proportion to the greater dia-

meter of the canal, thicker, and there is a greater number of vessels in the jejunum that circulate the blood. When it is laid open, we find the *valvulæ conniventes* more remarkable; and the villi, or farther division of the several valves, likewise larger. Every one of these circumstances may be accounted for upon the most simple principles. There is a greater quantity of food passing through the jejunum than the ilium, so the feculent matter, as it descends, becomes more consistent, and is more observed in the ilium. Hence the necessity that a greater surface should be applied in the jejunum, for the separation of those liquors from the blood, which serve to animalize and dissolve the food. The surface is increased for the purpose of greater absorption; and, for the better execution of both, the valves are made larger to stop the too easy passage of the food. Descending downwards, the mesentery becomes somewhat looser, and the bowels are more moveable; but there is, by no means such a change of place as appears in a dead body.

#### DCCLIX.

From the great length of the mesentery, especially of the lower parts of it, we can conceive two circumstances possible. That the mesentery and gut may be twisted by a violent exertion; and, if the omentum is of an unusual length, and there is a great quantity of fat, this may in like

manner entangle the intestine, being twisted round a portion of it.

## DCCLX.

The end of the intestinum ilium enters the great intestine; and of late years it has been proposed, that in certain cases, where one part of the intestine falls within another, attempts should be made to disentangle them, by throwing injections into the colon.

## DCCLXI.

In the appendix vermiformis, the mucous pores are comparatively very large; and it probably, therefore, serves to secrete a quantity of mucus to be added to the feculent matter; and in the greater part of the ape kind, where that is wanting, it is supplied by a spongy substance, immediately under the valve of the colon.

## DCCLXII.

From the appendix vermiformis the three ligaments come out, and this part is to be considered as the bottom of the caput cæcum coli, its situation being altered by the weight of the matter and by use; and the advantage of this is, that the fibres should all come from one point; for these being all in action at the same time, and this part being tied down by the peritonæum passing over it without a mesocolon, the other parts of the colon are drawn towards that for the shortening of the intestine by means of the longitudinal fibres; and the colon, from the several turns it



makes, is contiguous to almost all the abdominal viscera, which is a circumstance that ought never to be lost sight of, otherwise very considerable mistake may take place in judging of diseases, or in treating them.

## DCCLXIII.

In examining the relative use of the different parts of the intestines in respect to our aliment, we observe that the small intestines are intended to promote the formation of chyle, to allow it to be absorbed, and to propel the remains of the food into the next division, or large ones. That, by the next division, viz. the cæcum and beginning of the colon, the food received from the ilium is retained for some time; and in consequence of farther absorption, acquires a greater degree of consistency, and receives also a foetid smell; that in the colon, the excrementitious part alone is received, retained, and changed into fæces; and, by the peristaltic motion of the intestines, and the power of respiration, they are pushed by slow degrees into the rectum. In the rectum, the fæces are retained a certain time; till, by their weight and acrid nature, it is stimulated to discharge them, which it does by the power of its muscular coat, and of the levator ani, assisted by the diaphragm and abdominal muscles.

END OF THE FIRST VOLUME.





